CIVIL AVIATION GUIDANCE MATERIAL – 1902

SAFETY MANAGEMENT SYSTEM (SMS)

CIVIL AVIATION AUTHORITY OF MALAYSIA

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Introduction

This Civil Aviation Guidance Material 1902 (CAGM – 1902) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for Safety Management System (SMS), pursuant to Civil Aviation Directives 19 – Safety Management (CAD 19 – Safety Management).

Service providers may use these guidelines to demonstrate compliance with the provisions of the relevant CAD's issued. Notwithstanding Regulation 167 of the Malaysian Civil Aviation Regulations 2016 (MCAR) 2016 and Regulation 15 of Civil Aviation (Aerodrome Operations) Regulations 2016, when the CAGMs issued by the CAAM are used, the related requirements of the CAD's are considered as met, and further demonstration may not be required.

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Civil Aviation Guidance Material Components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Appendices: Material grouped separately for convenience but forms part of the Standards and Recommended Practices stipulated by the CAAM.

Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Tables and Figures: These add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

Attachments: Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

It is to be noted that some Standards in this Civil Aviation Guidance Material incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons.

Record of Revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

ISS/REV No.	Revision Date	Revision Details	Initials

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Summary of Changes

ISS/REV no.	Item no.	Revision Details

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1 Application

1.1 The purpose of an SMS is to provide service providers with a systematic approach to managing safety. It is designed to continuously improve safety performance through: the identification of hazards, the collection and analysis of safety data and safety information, and the continuous assessment of safety risks. The SMS seeks to proactively mitigate safety risks before they result in aviation accidents and incidents. It allows service providers to effectively manage their activities, safety performance and resources, while gaining a greater understanding of their contribution to aviation safety. An effective SMS demonstrates to the CAAM the service provider's ability to manage safety risks and provides for effective management of safety at the State level.

1.2 Pursuant to Regulation 167(2) of Civil Aviation Regulations (MCAR) 2016, a safety management system shall be made acceptable to—

a) in the case of an air traffic service provider, the Secretary General of the Minister of Transport; and

b) in the case of as service provider other than air traffic service provider, the CAAM.

1.3 Pursuant to Regulation 15 of Civil Aviation (Aerodrome Operations) Regulations 2016, an aerodrome operator who maintains or operates a Category 1 or 3 aerodrome shall establish a safety management system and shall ensure that the safety management system is maintained, implemented and complied with.

1.4 Applicant for the initial acceptance of SMS and nomination of safety manager shall submit to CAAM—

a) Application form CAAM/SMS/1902-00 (refer to Appendix 1);

b) SMS manual (refer to Appendix 2 for guidance on the development of an SMS manual);

c) SMS Gap Analysis Checklist CAAM/SMS/1902-01 and Implementation Plan (refer to Appendix 4);

d) Initial SMS Acceptance Checklist CAAM/SMS/1902-02 (refer to Appendix 5); and

e) Proposed Safety Performance Indicators (SPIs) and Safety Performance Targets (SPTs).

1.5 For the purpose of the continuation of SMS acceptance, the service provider shall be subjected to periodic surveillance and inspection by CAAM. The service provider shall conduct a self-assessment using SMS Maturity Checklist CAAM/SMS/1902-03 (refer to Appendix 6).

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2 SMS Framework

2.1 CAD - 19 specifies the framework for the implementation and maintenance of an SMS. Regardless of the service provider's size and complexity, all elements of the SMS framework apply. The implementation should be tailored to the organisation and its activities.

2.2 The SMS framework is made up of the following four components and twelve elements as shown in Table 2-1 below:

COMPONENT	*ELEMENT*
1. Safety policy and objectives	1.1 Management commitment
	1.2 Safety accountability and responsibilities
	1.3 Appointment of key safety personnel
	1.4 Coordination of emergency response planning
	1.5 SMS documentation
2. Safety risk management	2.1 Hazard identification
	2.2 Safety risk assessment and mitigation
3. Safety assurance	3.1 Safety performance monitoring and measurement
	3.2 The management of change
	3.3 Continuous improvement of the SMS
4. Safety promotion	4.1 Training and education
	4.2 Safety communication

Table 2-1: Components and elements of the SMS framework

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3 Component 1: Safety Policy and Objectives

3.1 The first component of the SMS framework focuses on creating an environment where safety management can be effective. It is founded on a safety policy and objectives that set out senior management's commitment to safety, its goals and the supporting organisational structure.

3.2 Management commitment and safety leadership is key to the implementation of an effective SMS and is asserted through the safety policy and the establishment of safety objectives. Management commitment to safety is demonstrated through management decision-making and allocation of resources; these decisions and actions should always be consistent with the safety policy and objectives to cultivate a positive safety culture.

3.3 The safety policy should be developed and endorsed by senior management, and is to be signed by the accountable executive. Key safety personnel, and where appropriate, staff representative bodies (employee forums, trade unions) should be consulted in the development of the safety policy and safety objectives to promote a sense of shared responsibility.

3.4 Management commitment

Safety policy

3.4.1 The safety policy should be visibly endorsed by senior management and the accountable executive. "Visible endorsement" refers to making management's active support of the safety policy visible to the rest of the organisation. This can be done via any means of communication and through the alignment of activities to the safety policy.

3.4.2 It is the responsibility of management to communicate the safety policy throughout the organisation to ensure all personnel understand and work in accordance with the safety policy.

3.4.3 To reflect the organisation's commitment to safety, the safety policy should include a commitment to:

a) continuously improve the level of safety performance;

b) promote and maintain a positive safety culture within the organisation;

c) comply with all applicable regulatory requirements;

d) provide the necessary resources to deliver a safe product or service;

e) ensure safety is a primary responsibility of all managers; and

f) ensure it is understood, implemented and maintained at all levels.

3.4.4 The safety policy should also make reference to the safety reporting system to encourage the reporting of safety issues and inform personnel of the

disciplinary policy applied in the case of safety events or safety issues that are reported.

3.4.5 The disciplinary policy is used to determine whether an error or rule breaking has occurred so that the service providers can establish whether any disciplinary action should be taken. To ensure the fair treatment of persons involved, it is essential that those responsible for making that determination have the necessary technical expertise so that the context of the event may be fully considered.

3.4.6 A policy on the protection of safety data and safety information, as well as reporters, can have a positive effect on the reporting culture. The service provider should establish policy and procedures for de-identification and aggregation of reports to allow meaningful safety analyses to be conducted without having to implicate personnel or specific service providers.

Safety objectives

3.4.7 Taking into consideration its safety policy, the service provider should also establish safety objectives to define what it aims to achieve in respect of safety outcomes. Safety objectives should be short, high-level statements of the service provider's safety priorities and should address its most significant safety risks. Safety objectives may be included in the safety policy (or documented separately), and defines what the service provider intends to achieve in terms of safety. Safety performance indicators (SPIs) and safety performance targets (SPTs) are needed to monitor the achievement of these safety objectives and are further elaborated on later in Chapter 5 of this CAGM.

3.4.8 The safety policy and safety objectives should be periodically reviewed to ensure they remain current (a change in the accountable executive would require its review for instance).

3.5 Safety accountability and responsibilities

Accountable executive

3.5.1 The accountable executive, typically the chief executive officer, is the person who has ultimate authority over the safe operation of the organisation. The accountable executive establishes and promotes the safety policy and safety objectives that instil safety as a core organisational value. The accountable executive should: have the authority to make decisions on behalf of the organisation, have control of resources, both financial and human, be responsible for ensuring appropriate actions are taken to address safety issues and safety risks, and they should be responsible for responding to accidents and incidents.

3.5.2 There might be challenges for the service provider to identify the most appropriate person to be the accountable executive, especially in large complex organisations with multiple entities and multiple certificates, authorisations or approvals. It is important the person selected is organisationally situated at the highest level of the organisation, thus ensuring the right strategic safety decisions are made.

3.5.3 The service provider is required to identify the accountable executive, placing the responsibility for the overall safety performance at a level in the organisation with the authority to take action to ensure the SMS is effective. Specific safety accountabilities of all members of management should be defined and their role in relation to the SMS should reflect how they can contribute towards a positive safety culture. The safety responsibilities, accountabilities and authorities should be documented and communicated throughout the organisation. The safety accountabilities of managers should include the allocation of the human, technical, financial or other resources necessary for the effective and efficient performance of the SMS.

Note. — The term "accountability" refers to obligations which cannot be delegated. The term "responsibilities" refers to functions and activities which may be delegated.

3.5.4 In the case where an SMS applies to several different certificates, authorisations or approvals that are all part of the same legal entity, there should be a single accountable executive. Where this is not possible, individual accountable executives should be identified for each organisational certificate, authorisation or approval and clear lines of accountability defined; it is also important to identify how their safety accountabilities will be coordinated.

3.5.5 One of the most effective ways the accountable executive can be visibly involved, is by leading regular executive safety meetings. As they are ultimately responsible for the safety of the organisation, being actively involved in these meetings allows the accountable executive to:

a) review safety objectives;

b) monitor safety performance and the achievement of safety targets;

c) make timely safety decisions;

d) allocate appropriate resources;

e) hold managers accountable for safety responsibilities, performance and implementation timelines; and

f) be seen by all personnel as an executive who is interested in, and in charge of, safety.

3.5.6 The accountable executive is not usually involved in the day-to-day activities of the organisation or the problems faced in the workplace and should ensure

there is an appropriate organisational structure to manage and operate the SMS. Safety management responsibility is often delegated to the senior management team and other key safety personnel. Although responsibility for the day-to-day operation of the SMS can be delegated, the accountable executive cannot delegate accountability for the system nor can decisions regarding safety risks be delegated. For example, the following safety accountabilities cannot be delegated:

a) ensuring safety policies are appropriate and communicated;

b) ensuring necessary allocation of resources (financing, personnel, training, acquisition); and

c) setting of the acceptable safety risk limits and resourcing of necessary controls.

3.5.7 It is appropriate for the accountable executive to have the following safety accountabilities:

a) provide enough financial and human resources for the proper implementation of an effective SMS;

b) promote a positive safety culture;

c) establish and promote the safety policy;

d) establish the organisation’s safety objectives;

e) ensure the SMS is properly implemented and performing to requirements; and

f) see to the continuous improvement of the SMS.

3.5.8 The accountable executive’s authorities include, but are not limited to, having final authority:

a) for the resolution of all safety issues; and

b) over operations under the certificate, authorisation or approval of the organisation, including the authority to stop the operation or activity.

3.5.9 The authority to make decisions regarding safety risk tolerability should be defined. This includes who can make decisions on the acceptability of risks as well as the authority to agree that a change can be implemented. The authority may be assigned to an individual, a management position or a committee.

3.5.10 Authority to make safety risk tolerability decisions should be commensurate with the manager's general decision-making and resource allocation authority. A lower-level manager (or management group) may be authorised to make tolerability decisions up to a certain level. Risk levels that exceed the manager's authority must be escalated for consideration to a higher management level with greater authority.

Accountability and responsibilities

3.5.11 Accountabilities and responsibilities of all personnel, management and staff, involved in safety-related duties supporting the delivery of safe products and operations should be clearly defined. The safety responsibilities should focus on the staff member's contribution to the safety performance of the organisation (the organisational safety outcomes). The management of safety is a core function; as such every senior manager has a degree of involvement in the operation of the SMS.

3.5.12 All defined accountabilities, responsibilities and authorities should be stated in the service provider's SMS documentation and should be communicated throughout the organisation. The safety accountabilities and responsibilities of each senior manager are integral components of their job descriptions. This should also capture the different safety management functions between line managers and the safety manager (see 3.6 for further details).

3.5.13 Lines of safety accountability throughout the organisation and how they are defined will depend on the type and complexity of the organisation, and their preferred communication methods. Typically, the safety accountabilities and responsibilities will be reflected in organisational charts, documents defining departmental responsibilities, and personnel job or role descriptions.

3.5.14 The service provider should aim to avoid conflicts of interest between staff members' safety responsibilities and their other organisational responsibilities. The service providers should allocate their SMS accountabilities and responsibilities, in a way that minimises any overlaps and/or gaps.

Accountability and responsibilities and in respect to external organisations

3.5.15 A service provider is responsible for the safety performance of external organisations where there is an SMS interface. The service provider may be held accountable for the safety performance of products or services provided by external organisations supporting its activities even if the external organisations are not required to have an SMS. It is essential for the service provider's SMS to interface with the safety systems of any external organisations that contribute to the safe delivery of their product or services.

3.6 Appointment of key safety personnel

3.6.1 Appointment of a competent person or persons by the service provider to fulfil the role of safety manager is essential to an effectively implemented and functioning SMS. The safety manager may be identified by different titles. For the purposes of this CAGM, the generic term "safety manager" is used and refers to the function, not necessarily to the individual. The person carrying out the safety manager function is responsible to the accountable executive for the performance of the SMS and for the delivery of safety services to the other departments in the

organisation. The nomination of a safety manager shall be subject to the acceptance by CAAM.

3.6.2 The safety manager advises the accountable executive and line managers on safety management matters, and is responsible for coordinating and communicating safety issues within the organisation as well as with external members of the aviation community. Functions of the safety manager include, but are not limited to:

a) manage the SMS implementation plan on behalf of the accountable executive (upon initial implementation);

b) perform/facilitate hazard identification and safety risk analysis;

c) monitor corrective actions and evaluate their results;

d) provide periodic reports on the organisation's safety performance;

e) maintain SMS documentation and records;

f) plan and facilitate staff safety training;

g) provide independent advice on safety matters;

h) monitor safety concerns in the aviation industry and their perceived impact on the organisation's operations aimed at product and service delivery; and

i) coordinate and communicate (on behalf of the accountable executive) with the CAAM on issues relating to safety.

3.6.3 The safety manager advises the accountable executive and line managers on safety management matters, and is responsible for coordinating and communicating safety issues within the organisation as well as with external members of the aviation community. Functions of the safety manager include, but are not limited to:

a) competition for funding (e.g. financial manager being the safety manager);

b) conflicting priorities for resources; and

c) where the safety manager has an operational role and the ability to assess the SMS effectiveness of the operational activities the safety manager is involved in.

3.6.4 In cases where the function is allocated to a group of persons, (e.g. when service providers extend their SMS across multiple activities) one of the persons should be designated as "lead" safety manager, to maintain a direct and unequivocal reporting line to the accountable executive.

3.6.5 The competencies for a safety manager should include, but not be limited to, the following:

a) safety/ quality management experience;

b) operational experience related to the product or service provided by the service providers;

c) technical background to understand the systems that support operations or the product/service provided;

d) interpersonal skills;

e) analytical and problem-solving skills;

f) project management skills;

g) oral and written communications skills; and

h) an understanding of human factors.

Note. — Detailed job description for a safety manager is specified in Appendix 3 of this CAGM.

3.6.6 Depending on the size, nature and complexity of the organisation, additional staff may support the safety manager. The safety manager and supporting staff are responsible for ensuring the prompt collection and analysis of safety data and appropriate distribution within the organisation of related safety information such that safety risk decisions and controls, as necessary, can be made.

3.6.7 Service providers should establish appropriate safety committees that support the SMS functions across the organisation. This should include determining who should be involved in the safety committee and frequency of the meetings.

3.6.8 The highest-level safety committee, sometimes referred to as a safety review board (SRB), includes the accountable executive and senior managers with the safety manager participating in an advisory capacity. The SRB is strategic and deals with high-level issues related to safety policies, resource allocation and organisational performance. The SRB monitors the:

a) effectiveness of the SMS;

b) timely response in implementing necessary safety risk control actions;

c) safety performance against the organisation’s safety policy and objectives;

d) overall effectiveness of safety risk mitigation strategies;

e) effectiveness of the organisation’s safety management processes which support:

1) the declared organisational priority of safety management; and
2) promotion of safety across the organisation.

3.6.9 Once a strategic direction has been developed by the highest-level safety committee, implementation of safety strategies should be coordinated throughout the organisation. This may be accomplished by creating safety action groups (SAGs) that are more operationally focused. SAGs are normally composed of

managers and front-line personnel and are chaired by a designated manager. SAGs are tactical entities that deal with specific implementation issues in accordance with the strategies developed by the SRB. The SAGs:

a) monitor operational safety performance within their functional areas of the organisation and ensure that appropriate SRM activities are carried out;

b) review available safety data and identify the implementation of appropriate safety risk control strategies and ensure employee feedback is provided;

c) assess the safety impact related to the introduction of operational changes or new technologies;

d) coordinate the implementation of any actions related to safety risk controls and ensure that actions are taken promptly; and

e) review the effectiveness of specific safety risk controls.

3.7 Coordination of emergency response planning

3.7.1 By definition, an emergency is a sudden, unplanned situation or event requiring immediate action. Coordination of emergency response planning refers to planning for activities that take place within a limited period of time during an unplanned aviation operational emergency situation. An emergency response plan (ERP) is an integral component of a service provider's SRM process to address aviation-related emergencies, crises or events. Where there is a possibility of a service provider's aviation operations or activities being compromised by emergencies such as a public health emergency/pandemic, these scenarios should also be addressed in its ERP as appropriate. The ERP should address foreseeable emergencies as identified through the SMS and include mitigating actions, processes and controls to effectively manage aviation-related emergencies.

3.7.2 The overall objective of the ERP is the safe continuation of operations and the return to normal operations as soon as possible. This should ensure an orderly and efficient transition from normal to emergency operations, including assignment of emergency responsibilities and delegation of authority. It includes the period of time required to re-establish "normal" operations following the emergency. The ERP identifies actions to be taken by responsible personnel during an emergency. Most emergencies will require coordinated action between different organisations, possibly with other service providers and with other external organisations such as non-aviation-related emergency services. The ERP should be easily accessible to the appropriate key personnel as well as to the coordinating external organisations.

3.7.3 Coordination of emergency response planning applies only to those service providers required to establish and maintain an ERP. This coordination should be exercised as part of the periodic testing of the ERP.

3.8 SMS Documentation

3.8.1 The SMS documentation should include a top-level "SMS manual", which describes the service provider's SMS policies, processes and procedures to facilitate the organisation's internal administration, communication and maintenance of the SMS. It should help personnel to understand how the organisation's SMS functions, and how the safety policy and objectives will be met. The documentation should include a system description that provides the boundaries of the SMS. It should also help clarify the relationship between the various policies, processes, procedures and practices, and define how these link to the service provider's safety policy and objectives. The documentation should be adapted and written to address the day-to-day safety management activities that can be easily understood by personnel throughout the organisation.

3.8.2 The SMS manual also serves as a primary safety communication tool between the service provider and key safety stakeholders (e.g. CAAM for the purpose of regulatory acceptance, assessment and subsequent monitoring of the SMS). The SMS manual may be a stand-alone document, or it may be integrated with other organisational documents (or documentation) maintained by the service provider. Where details of the organisation's SMS processes are already addressed in existing documents, appropriate cross-referencing to such documents is enough. This SMS document must be kept up to date. CAAM acceptance is required before significant amendments are made to the SMS manual, as it is a controlled manual. The manual may be subject to endorsement or approval by CAAM as evidence of its acceptance.

3.8.3 The SMS manual should include a detailed description of the service provider's policies, processes and procedures including:

a) safety policy and safety objectives;

b) reference to any applicable regulatory SMS requirements;

c) system description;

d) safety accountabilities and key safety personnel;

e) voluntary and mandatory safety reporting system processes and procedures;

f) hazard identification and safety risk assessment processes and procedures;

g) safety investigation procedures;

h) procedures for establishing and monitoring safety performance indicators;

i) SMS training processes and procedures and communication;

j) safety communication processes and procedures;

k) internal audit procedures;

l) management of change procedures;

m) SMS documentation management procedures; and

n) where applicable, coordination of emergency response planning.

Note. — Detailed guidance on the development of SMS manual is specified in Appendix 2 of this CAGM.

3.8.4 SMS documentation also includes the compilation and maintenance of operational records substantiating the existence and ongoing operation of the SMS. Operational records are the outputs of the SMS processes and procedures such as the SRM and safety assurance activities. SMS operational records should be stored and kept in accordance with existing retention periods. Typical SMS operational records should include:

a) hazards register and hazard/safety reports;

b) SPIs and related charts;

c) record of completed safety risk assessments;

d) SMS internal review or audit records;

e) internal audit records;

f) records of SMS/safety training records;

g) SMS/safety committee meeting minutes;

h) SMS implementation plan (during the initial implementation); and

i) gap analysis to support implementation plan.

4 Component 2: Safety Risk Management

4.1 Service providers should ensure they are managing their safety risks. This process is known as safety risk management (SRM), which includes hazard identification, safety risk assessment and safety risk mitigation.

4.2 The SRM process systematically identifies hazards that exist within the context of the delivery of its 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 service provider's operating environment. Careful analysis of these factors can often identify potential hazards at any point in the operation or activity life cycle.

4.3 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. Safety risk assessments and safety risk mitigations will need to be continuously reviewed to ensure they remain effective. Figure 4-1 provides an overview of the hazard identification and safety risk management process for a service provider.

Note. — Detailed guidance on hazard identification and safety risk assessment procedures is addressed in Chapter 8 of this CAGM.

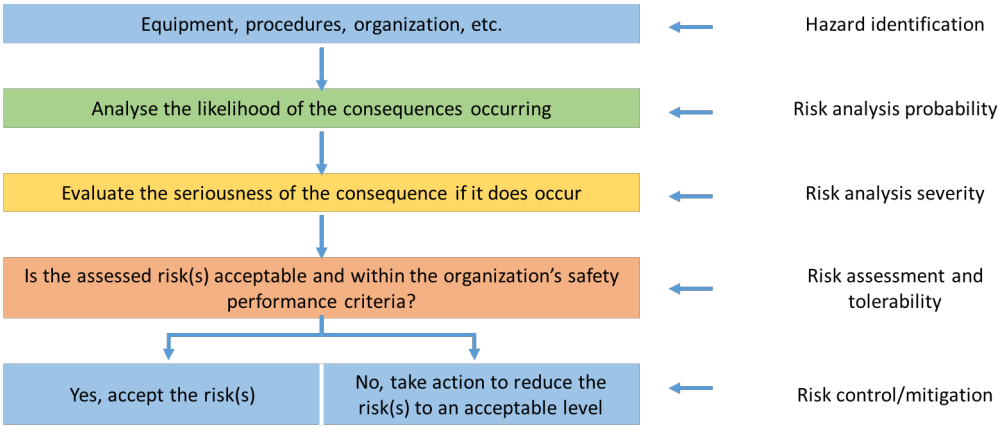

Figure 4-1: Hazard identification and risk management process

4.4 Hazard identification

Hazard identification is the first step in the SRM process. The service provider should develop and maintain a formal 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 organisations.

Sources for hazard identification

4.4.1 There are a variety of sources for hazard identification, internal or external to the organisation. Some internal sources include:

a) Normal operations monitoring; this uses observational techniques to monitor the day-to-day operations and activities such as line operations safety audit (LOSA).

b) Automated monitoring systems; this uses automated recording systems to monitor parameters that can be analysed such as flight data monitoring (FDM).

c) Voluntary and mandatory safety reporting systems; this provides everyone, including staff from external organisations, with opportunities to report hazards and other safety issues to the organisation.

d) Audits; these can be used to identify hazards in the task or process being audited. These should also be coordinated with organisational 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) Service provider safety investigations; hazards identified in internal safety investigation and follow-up reports on accidents/incidents.

4.4.2 Examples of external sources for hazard identification include:

a) *Aviation accident reports*; reviewing accident reports; this may be related to accidents in the same State or to a similar aircraft type, region or operational environment.

b) State mandatory and voluntary safety reporting systems.

c) *State oversight audits and third-party audits*; external audits can sometimes identify hazards. These may be documented as an unidentified hazard or captured less obviously within an audit finding.

d) Trade associations and information exchange systems.

Safety reporting system

4.4.3 One of the main sources for identifying hazards is the safety reporting system, especially the voluntary safety reporting system. Whereas the mandatory system is normally used for incidents that have occurred, the voluntary system provides an additional reporting channel for potential safety issues such as hazards, near misses or errors. They can provide valuable information to the CAAM and service provider on lower consequence events.

4.4.4 It is important that service providers provide appropriate protections to encourage people to report what they see or experience. For example, enforcement action may be waived for reports of errors, or in some circumstances, rule-breaking. It should be clearly stated that reported information will be used solely to support the enhancement of safety. The intent is to promote an effective reporting culture and proactive identification of potential safety deficiencies.

4.4.5 Voluntary safety reporting systems should be confidential, requiring that any identifying information about the reporter is known only to the custodian to allow for follow-up action. The role of custodian should be kept to a few individuals, typically restricted to the safety manager and personnel involved in the safety investigation. Maintaining confidentiality will help facilitate the disclosure of hazards leading to human error, without fear of retribution or embarrassment. Voluntary safety reports may be de-identified and archived once necessary follow-up actions are taken. De-identified reports can support future trending analyses to track the effectiveness of risk mitigation and to identify emerging hazards.

4.4.6 Personnel at all levels and across all disciplines are encouraged to identify and report hazards and other safety issues through their safety reporting systems. To be effective, safety reporting systems should be readily accessible to all personnel. Depending on the situation, a paper-based, web-based or desktop form can be used. Having multiple entry methods available maximizes the likelihood of staff engagement. Everyone should be made aware of the benefits of safety reporting and what should be reported.

4.4.7 Anybody who submits a safety report should receive feedback on what decisions or actions have been taken. The alignment of reporting system requirements, analysis tools and methods can facilitate exchange of safety information as well as comparisons of certain safety performance indicators. Feedback to reporters in voluntary reporting schemes also serves to demonstrate that such reports are considered seriously. This helps to promote a positive safety culture and encourage future reporting.

4.4.8 There may be a need to filter reports on entry when there are a large number of safety reports. This may involve an initial safety risk assessment to determine whether further investigation is necessary and what level of investigation is required.

4.4.9 Safety reports are often filtered through the use of a taxonomy, or a classification system. Filtering information using a taxonomy can make it easier to identify common issues and trends. The service provider should develop taxonomies that cover their type(s) of operation. The disadvantage of using a taxonomy is that sometimes the identified hazard does not fit cleanly into any of the defined categories. The challenge then is to use taxonomies with the appropriate degree of detail; specific enough that hazards are easy to allocate, yet generic enough that the hazards are valuable for analysis. Chapter 9 of this CAGM provides additional information on hazard taxonomies.

4.4.10 Other methods of hazard identification include workshops or meetings in which subject matter experts conduct detailed analysis scenarios. These sessions benefit from the contributions of a range of experienced operational and technical personnel. Existing safety committee meetings (SRB, SAG, etc.) could be used for such activities; the same group may also be used to assess associated safety risks.

4.4.11 Identified hazards and their potential consequences should be documented. This will be used for safety risk assessment processes.

4.4.12 The hazard identification process considers all possible hazards that may exist within the scope of the service provider's aviation activities including interfaces with other systems, both within and external to the organisation. Once hazards are identified, their consequences (i.e. any specific events or outcomes) should be determined.

Investigation of hazards

4.4.13 Hazard identification should be continuous and part of the service provider's ongoing activities. Some conditions may merit more detailed investigation. These may include:

a) instances where the organisation experiences an unexplained increase in aviation safety-related events or regulatory non-compliance; or

b) significant changes to the organisation or its activities.

4.5 Service provider safety investigation

4.5.1 Effective safety management depends on quality investigations to analyse safety occurrences and safety hazards, and report findings and recommendations to improve safety in the operating environment:

4.5.2 There is a clear distinction between accident and incident investigations under Annex 13 and service provider safety investigations. Investigation of accidents and serious incidents under Annex 13 are the responsibility of the Air Accident Investigation Bureau (AAIB). This type of information is essential to disseminate lessons learned from accidents and incidents. Service provider safety investigations are conducted by service providers as part of their SMS to support hazard identification and risk assessment processes. There are many safety occurrences that fall outside of Annex 13 that could provide a valuable source of hazard identification or identify weaknesses in risk controls. These problems might be revealed and remedied by a safety investigation led by the service provider.

4.5.3 The primary objective of the service provider safety investigation is to understand what happened, and how to prevent similar situations from occurring in the future by eliminating or mitigating safety deficiencies. This is achieved through careful

and methodical examination of the event and by applying the lessons learned to reduce the probability and/or consequence of future recurrences. Service provider safety investigations are an integral part of the service provider's SMS.

4.5.4 Service provider investigations of safety occurrences and hazards are an essential activity of the overall risk management process in aviation. 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 organisational 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.

Investigation triggers

4.5.5 A service provider safety investigation is usually triggered by a notification (report) submitted through the safety reporting system. Figure 4-2 outlines the safety investigation decision process and the distinction between when a service provider safety investigation should take place and when an investigation under Annex 13 provisions should be initiated:

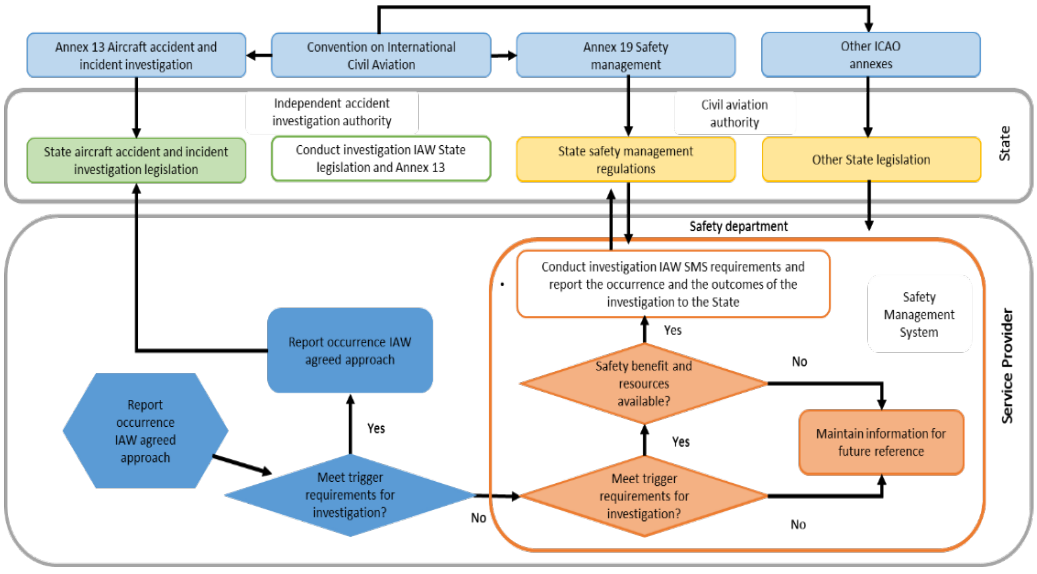

Figure 4-2: Safety investigation decision process

4.5.6 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. Service providers should use a structured decision-making approach with defined trigger points. 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 organisational 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 programmes;

g) identified trends;

h) training benefit; and

i) resources availability.

Assigning an investigator

4.5.7 If an investigation is to commence, the first action will be to appoint an investigator or where the resources are available, an investigation team with the required skills and expertise. The size of the team and the expertise profile of its members depend on the nature and severity of the occurrence being investigated. The investigating team may require the assistance of other specialists. Often, a single person is assigned to carry out an internal investigation, with support from operations and safety office experts.

4.5.8 Service provider safety investigators are ideally organisationally independent from the area associated with the occurrence or identified hazard. Better results will be obtained if the investigator(s) are knowledgeable (trained) and skilled (experienced) in service provider safety investigations. The investigators would ideally be chosen for the role because of their knowledge, skills and character traits, which should include: integrity, objectivity, logical thinking, pragmatism, and lateral thinking.

The investigation processes

4.5.9 The investigation should identify what happened and why it happened and this may 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;

d) identifying any risk controls that were in place that should have prevented the event occurring; and

e) reviewing safety data for any previous or similar events.

4.5.10 The safety investigation should focus on the identified hazards and safety risks and opportunities for improvement, not on blame or punishment. The way the investigation is conducted, and most importantly, how the report is written, will influence the likely safety impact, the future safety culture of the organisation, and the effectiveness of future safety initiatives.

4.5.11 The investigation should conclude with clearly defined findings and recommendations that eliminate or mitigate safety deficiencies.

4.6 Safety risk assessment and mitigation

4.6.1 The service provider must develop a safety risk assessment model and procedures which will allow a consistent and systematic approach for the assessment of safety risks. This should include a method that will help determine what safety risks are acceptable or unacceptable and to prioritize actions.

4.6.2 The SRM tools used may need to be reviewed and customized periodically to ensure they are suitable for the service provider's operating environment. The service provider may find more sophisticated approaches that better reflect the needs of their operation as their SMS matures. The service provider and CAAM should agree on a methodology.

4.6.3 More sophisticated approaches to safety risk classification are available. These may be more suitable if the service provider is experienced with safety management or operating in a high-risk environment.

4.6.4 The safety risk assessment process should use whatever safety data and safety information is available. Once safety risks have been assessed, the service provider will engage in a data-driven decision-making process to determine what safety risk controls are needed.

4.6.5 Safety risk assessments sometimes have to use qualitative information (expert judgement) rather than quantitative data due to unavailability of data. Using the safety risk matrix allows the user to express the safety risk(s) associated with the identified hazard in a quantitative format. This enables direct magnitude comparison between identified safety risks. A qualitative safety risk assessment criterion such as "likely to occur" or "improbable" may be assigned to each identified safety risk where quantitative data is not available.

4.6.6 For service providers that have operations in multiple locations with specific operating environments, it may be more effective to establish local safety committees to conduct safety risk assessments and safety risk control identification. Advice is often sought from a specialist in the operational area (internal or external to the service provider). Final decisions or control acceptance may be required from higher authorities so that the appropriate resources are provided.

4.6.7 How service providers go about prioritizing their safety risk assessments and adopting safety risk controls is their decision. As a guide, the service provider should find the prioritization process:

a) assesses and controls highest safety risk;

b) allocates resources to highest safety risks;

c) effectively maintains or improves safety;

d) achieves the stated and agreed safety objectives and SPTs; and

e) satisfies the CAAM's requirements with regard to control of safety risks.

4.6.8 After safety risks have been assessed, appropriate safety risk controls can be implemented. It is important to involve the "end users" and subject matter experts in determining appropriate safety risk controls. Ensuring the right people are involved will maximize the practicality of safety risk chosen mitigations. A determination of any unintended consequences, particularly the introduction of new hazards, should be made prior to the implementation of any safety risk controls.

4.6.9 Once the safety risk control has been agreed and implemented, the safety performance should be monitored to assure the effectiveness of the safety risk control. This is necessary to verify the integrity, efficiency and effectiveness of the new safety risk controls under operational conditions.

4.6.10 The SRM outputs should be documented. This should include the hazard and any consequences, the safety risk assessment and any safety risk control actions taken. These are often captured in a register so they can be tracked and monitored. This SRM documentation becomes a historical source of organisational safety knowledge which can be used as reference when making safety decisions and for safety information exchange. This safety knowledge provides material for safety trend analyses and safety training and communication. It is also useful for internal audits to assess whether safety risk controls and actions have been implemented and are effective.

5 Component 3: Safety Assurance

5.1 Civil Aviation Directive (CAD) 19 requires that service providers develop and maintain the means to verify the safety performance of the organisation and to validate the effectiveness of safety risk controls. The safety assurance component of the service provider's SMS provides these capabilities.

5.2 Safety assurance consists of processes and activities undertaken to determine whether the SMS is operating according to expectations and requirements. This involves continuously monitoring its processes as well as its operating environment to detect changes or deviations that may introduce emerging safety risks or the degradation of existing safety risk controls. Such changes or deviations may then be addressed through the SRM process.

5.3 Safety assurance activities should include the development and implementation of actions taken in response to any identified issues having a potential safety impact. These actions continuously improve the performance of the service provider's SMS.

5.4 Safety performance monitoring and measurement

To verify the safety performance and validate the effectiveness of safety risk controls requires the use of a combination of internal audits and the establishment and monitoring of SPIs. Assessing the effectiveness of the safety risk controls is important as their application does not always achieve the results intended. This will help identify whether the right safety risk control was selected and may result in the application of a different safety risk control strategy.

Internal audit

5.4.1 Internal audits are performed to assess the effectiveness of the SMS and identify areas for potential improvement. Ensuring compliance with the regulations through the internal audit is a principle aspect of safety assurance.

5.4.2 It is also necessary to ensure that any safety risk controls are effectively implemented and monitored. The causes and contributing factors should be investigated and analysed where non-conformances and other issues are identified. The main focus of the internal audit is on the policies, processes and procedures that provide the safety risk controls.

5.4.3 Internal audits are most effective when conducted by persons or departments independent of the functions being audited. Such audits should provide the accountable executive and senior management with feedback on the status of:

a) compliance with regulations;

b) compliance with policies, processes and procedures;

c) the effectiveness of safety risk controls;

d) the effectiveness of corrective actions; and

e) the effectiveness of the SMS

5.4.4 Some organisations cannot ensure appropriate independence of an internal audit, in such cases, the service provider should consider engaging external auditors (e.g. independent auditors or auditors from another organisation).

5.4.5 Planning of internal audits should take into account the safety criticality of the processes, the results of previous audits and assessments (from all sources), and the implemented safety risk controls. Internal audits should identify non-compliance with regulations and policies, processes and procedures. They should also identify system deficiencies, lack of effectiveness of safety risk controls and opportunities for improvement.

5.4.6 Assessing for compliance and effectiveness are both essential to achieving safety performance. The internal audit process can be used to determine both compliance and effectiveness. The following questions can be asked to assess compliance and effectiveness of each process or procedure:

a) Determining compliance

1) Does the required process or procedure exist?
2) Is the process or procedure documented (inputs, activities, interfaces and outputs defined)?
3) Does the process or procedure meet requirements (criteria)?
4) Is the process or procedure being used?
5) Are all affected personnel following the process or procedure consistently?
6) Are the defined outputs being produced?
7) Has a process or procedure change been documented and implemented?

b) Assessing effectiveness

1) Do users understand the process or procedure?
2) Is the purpose of the process or procedure being achieved consistently?
3) Are the results of the process or procedure what the “customer” asked for?
4) Is the process or procedure regularly reviewed?
5) Is a safety risk assessment conducted when there are changes to the process or procedure?
6) Have process or procedure improvements resulted in the expected benefits?

5.4.7 In addition, internal audits should monitor progress in closing previously identified non-compliances. These should have been addressed through root cause analysis and the development and implementation of corrective and preventive

action plans. The results from analysis of cause(s) and contributing factors for any non-compliance should feed into the service provider's SRM processes.

5.4.8 The results of the internal audit process become one of the various inputs to the SRM and safety assurance functions. Internal audits inform the service provider's management of the level of compliance within the organisation, the degree to which safety risk controls are effective and where corrective or preventive action is required.

Safety performance monitoring

5.4.9 Safety performance monitoring is conducted through the collection of safety data and safety information from a variety of sources typically available to an organisation. Data availability to support informed decision-making is one of the most important aspects of the SMS. Using this data for safety performance monitoring and measurement are essential activities that generate the information necessary for safety risk decision-making.

5.4.10 Safety performance monitoring and measurement should be conducted observing some basic principles. The safety performance achieved is an indication of organisational behaviour and is also a measure of the effectiveness of the SMS. This requires the organisation to define:

a) safety objectives, which should be established first to reflect the strategic achievements or desired outcomes related to safety concerns specific to the organisation's operational context;

b) SPIs, which are tactical parameters related to the safety objectives and therefore are the reference for data collection; and

c) SPTs, which are also tactical parameters used to monitor progress towards the achievement of the safety objectives.

5.4.11 A more complete and realistic picture of the service provider's safety performance will be achieved if SPIs encompass a wide spectrum of indicators. This should include:

a) low probability/high severity events (e.g. accidents and serious incidents);

b) high probability/low severity events (e.g. uneventful operational events, non-conformance reports, deviations etc.): and

c) process performance (e.g. training, system improvements and report processing).

5.4.12 SPIs are used to measure operational safety performance of the service provider and the performance of their SMS. SPIs rely on the monitoring of data and information from various sources including the safety reporting system. They should be specific to the individual service provider and be linked to the safety objectives already established.

5.4.13 When establishing SPIs service providers should consider:

a) Measuring the right things: Determine the best SPIs that will show the organisation is on track to achieving its safety objectives. Also consider what are the biggest safety issues and safety risks faced by the organisation, and identify SPIs which will show effective control of these.

b) Availability of data: Is there data available which aligns with what the organisation wants to measure? If there isn't, there may be a need to establish additional data collection sources. For small organisations with limited amounts of data, the pooling of data sets may also help to identify trends. This may be supported by industry associations who can collate safety data from multiple organisations.

c) Reliability of the data: Data may be unreliable either because of its subjectivity or because it is incomplete.

d) Common industry SPIs: It may be useful to agree on common SPIs with similar organisations so that comparisons can be made between organisations. The regulator or industry associations may enable these.

5.4.14 Once SPIs have been established the service provider should consider whether it appropriate to identify SPTs and alert levels. SPTs are useful in driving safety improvements but, implemented poorly, they have been known to lead to undesirable behaviours – that is, individuals and departments becoming too focused on achieving the target and perhaps losing sight of what the target was intended to achieve – rather than an improvement in organisational safety performance. In such cases it may be more appropriate to monitor the SPI for trends.

5.4.15 The following activities can provide sources to monitor and measure safety performance:

a) Safety studies are analyses to gain a deeper understanding of safety issues or better understand a trend in safety performance.

b) Safety data analysis uses the safety reporting data to uncover common issues or trends that might warrant further investigation.

c) Safety surveys examine procedures or processes related to a specific operation. Safety surveys may involve the use of checklists, questionnaires and informal confidential interviews. Safety surveys generally provide qualitative information. This may require validation via data collection to determine if corrective action is required. Nonetheless, surveys may provide an inexpensive and valuable source of safety information.

d) Safety audits focus on assessing the integrity of the service provider's SMS and supporting systems. Safety audits can also be used to evaluate the effectiveness of installed safety risk controls or to monitor compliance with safety regulations. Ensuring independence and objectivity is a challenge for

safety audits. Independence and objectivity can be achieved by engaging external entities or internal audits with protections in place - policies, procedures, roles, communication protocols.

e) Findings and recommendations from safety investigations can provide useful safety information that can be analysed against other collected safety data.

f) Operational data collection systems such as FDA, radar information can provide useful data of events and operational performance.

5.4.16 The development of SPIs should be linked to the safety objectives and be based on the analysis of data that is available or obtainable. The monitoring and measurement process involve the use of selected safety performance indicators, corresponding SPTs and safety triggers.

5.4.17 The organisation should monitor the performance of established SPIs and SPTs to identify abnormal changes in safety performance. SPTs should be realistic, context specific and achievable when considering the resources available to the organisation and the associated aviation sector.

5.4.18 Primarily, safety performance monitoring and measurement provides a means to verify the effectiveness of safety risk controls. In addition, they provide a measure of the integrity and effectiveness of SMS processes and activities.

5.4.19 During development of SPIs and SPTs, the service provider should consult CAAM for acceptance.

5.4.20 For more information about safety performance indicators and safety performance targets, refer to Chapter 10 of this CAGM.

5.5 The management of change

5.5.1 Service providers experience change due to a number of factors including, but not limited to:

a) organisational expansion or contraction;

b) 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;

c) changes to the organisation’s operating environment;

d) changes to the SMS interfaces with external organisations; and

e) external regulatory changes, economic changes and emerging risks.

5.5.2 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 organisation's existing hazard identification or SRM procedures.

5.5.3 The organisation's management of change process should take into account the following considerations:

a) Criticality. How critical is the change? The service provider should consider the impact on their organisation's activities, and the impact on other organisations 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 organisations.

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?

5.5.4 Small incremental changes often go unnoticed, but the cumulative effect can be considerable. Changes, large and small, might affect the organisation'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, given that most service providers experience regular, or even continuous, change.

5.5.5 The service provider should define the trigger for the formal change process. Changes that are likely to trigger formal change management include:

a) introduction of new technology or equipment;

b) changes in the operating environment;

c) changes in key personnel;

d) significant changes in staffing levels;

e) changes in safety regulatory requirements;

f) significant restructuring of the organisation; and

g) physical changes (new facility or base, aerodrome layout changes etc.).

5.5.6 The service provider should also consider 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.

5.5.7 The change management 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 organisation, other departments or external people or

organisations. Equipment, systems and processes may also be impacted. A review of the system description and organisations' 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;

c) 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 organisation's SRM processes;

d) 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;

e) 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

f) 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.

5.6 Continuous improvement of the SMS

5.6.1 CAD 19 requires that… "the service provider monitor and assess its SMS processes to maintain or continuously improve the overall effectiveness of the SMS." Maintenance and continuous improvement of the service provider's SMS effectiveness is supported by safety assurance activities that include the verification and follow up of actions and the internal audit processes. It should be recognized that maintaining and continuously improving the SMS is an ongoing journey as the organisation itself and the operational environment will be constantly changing.

5.6.2 Internal audits involve assessment of the service provider's aviation activities that can provide information useful to the organisation's decision-making processes. The internal audit function includes evaluation of all of the safety management functions throughout the organisation.

5.6.3 SMS effectiveness should not be based solely on SPIs; service providers should aim to implement a variety of methods to determine its effectiveness, measure outputs as well as outcomes of the processes, and assess the information gathered through these activities. Such methods may include:

a) *Audits*; this includes internal audits and audits carried out by other organisations.

b) *Assessments*; includes assessments of safety culture and SMS effectiveness.

c) *Monitoring of occurrences*; monitor the recurrence of safety events including accidents and incidents as well as errors and rule-breaking situations.

d) *Safety surveys*; including cultural surveys providing useful feedback on staff engagement with the SMS. It may also provide an indicator of the safety culture of the organisation.

e) *Management reviews*; examine whether the safety objectives are being achieved by the organisation and are an opportunity to look at all the available safety performance information to identify overall trends. It is important that senior management review the effectiveness of the SMS. This may be carried out as one of the functions of the highest-level safety committee.

f) *Evaluation of SPIs and SPTs*; possibly as part of the management review. It considers trends and, when appropriate data is available, can be compared to other service providers or regional or global data.

g) *Addressing lessons learnt*; from safety reporting systems and service provider safety investigations. These should lead to safety improvements being implemented.

5.6.4 In summary, the monitoring of the safety performance and internal audit processes contributes to the service provider's ability to continuously improve its safety performance. Ongoing monitoring of the SMS, its related safety risk controls and support systems assures the service provider and CAAM that the safety management processes are achieving the desired safety performance objectives.

6 Component 4: Safety Promotion

6.1 Safety promotion encourages a positive safety culture and helps achieve the service provider's safety objectives through the combination of technical competence that is continually enhanced through training and education, effective communication, and information-sharing. Senior management provides the leadership to promote the safety culture throughout an organisation.

6.2 Effective safety management cannot be achieved solely by mandate or strict adherence to policies and procedures. Safety promotion affects both individual and organisational behaviour, and supplements the organisation's policies, procedures and processes, providing a value system that supports safety efforts.

6.3 The service provider should establish and implement processes and procedures that facilitate effective two-way communication throughout all levels of the organisation. This should include clear strategic direction from the top of the organisation and the enabling of "bottom-up" communication that encourages open and constructive feedback from all personnel.

6.4 Training and education

6.4.1 CAD 19 requires that "the service provider shall develop and maintain a safety training programme that ensures that personnel are trained and competent to perform their SMS duties." It also requires that "the scope of the safety training programme be appropriate to each individual's involvement in the SMS." The safety manager is responsible for ensuring there is a suitable safety training programme in place. This includes providing appropriate safety information relevant to specific safety issues met by the organisation. Personnel who are trained and competent to perform their SMS duties, regardless of their level in the organisation, is an indication of management's commitment to an effective SMS. The training programme should include initial and recurrent training requirements to maintain competencies. Initial safety training should consider, as a minimum, the following.

a) organisational safety policies and safety objectives;

b) organisational roles and responsibilities related to safety;

c) basic SRM principles;

d) safety reporting systems;

e) the organisation's SMS processes and procedures; and

f) human factors.

6.4.2 Recurrent safety training should focus on changes to the SMS policies, processes and procedures, and should highlight any specific safety issues relevant to the organisation or lessons learned.

6.4.3 The training programme should be tailored to the needs of the individual's role within the SMS. For example, the level and depth of training for managers involved in the organisation's safety committees will be more extensive than for personnel directly involved with delivery of the organisation's product or services. Personnel not directly involved in the operations may require only a high-level overview of the organisation's SMS.

Training need analysis

6.4.4 For most organisations, a formal training needs analysis (TNA) is necessary to ensure there is a clear understanding of the operation, the safety duties of the personnel and the available training. A typical TNA will normally start by conducting an audience analysis, which usually includes the following steps:

a) Every one of the service provider's staff will be affected by the implementation of the SMS, but not in the same ways or to the same degree. Identify each staff grouping and in what ways they will interact with the safety management processes, inputs and outputs - in particular with safety duties. This information should be available from the position/role descriptions. Normally groupings of individuals will start to emerge that have similar learning needs. The service provider should consider whether it is valuable to extend the analysis to staff in external interfacing organisations;

b) Identify the knowledge and competencies needed to perform each safety duty and required by each staff grouping.

c) Conduct an analysis to identify the gap between the current safety skill and knowledge across the workforce and those needed to effectively perform the allocated safety duties.

d) Identify the most appropriate skills and knowledge development approach for each group with the aim of developing a training programme appropriate to each individual or group's involvement in safety management. The training programme should also consider the staff's ongoing safety knowledge and competency needs; these needs will typically be met through a recurrent training programme.

6.4.5 It is also important to identify the appropriate method for training delivery. The main objective is that, on completion of the training, personnel are competent to perform their SMS duties. Competent trainers are usually the single most important consideration; their commitment, teaching skills and safety management expertise will have a significant impact on the effectiveness of the training delivered. The safety training programme should also specify responsibilities for development of training content and scheduling as well as training and competency records management.

6.4.6 The organisation should determine who should be trained and to what depth, and this will depend on their involvement in the SMS. Most people working in the

organisation have some direct or indirect relationship with aviation safety, and therefore have some SMS duties. This applies to any personnel directly involved in the delivery of products and services, and personnel involved in the organisation's safety committees. Some administrative and support personnel will have limited SMS duties and will need some SMS training, as their work may still have an indirect impact on aviation safety.

6.4.7 The service provider should identify the SMS duties of personnel and use the information to examine the safety training programme and ensure each individual receives training aligned with their involvement with SMS. The safety training programme should specify the content of safety training for support staff, operational personnel, managers and supervisors, senior managers and the accountable executive.

6.4.8 There should be specific safety training for the accountable executive and senior managers that includes the following topics:

a) specific awareness training for new accountable executives and post holders on their SMS accountabilities and responsibilities;

b) importance of compliance with national and organisational safety requirements;

c) management commitment;

d) allocation of resources;

e) promotion of the safety policy and the SMS;

f) promotion of a positive safety culture;

g) effective interdepartmental safety communication;

h) safety objective, SPTs and alert levels; and

i) disciplinary policy.

6.4.9 The main purpose of the safety training programme is to ensure that personnel, at all levels of the organisation, maintain their competence to fulfil their safety roles; therefore, competencies of personnel should be reviewed on a regular basis.

6.5 Safety Communication

6.5.1 The service provider should communicate the organisation’s SMS objectives and procedures to all appropriate personnel. There should be a communication strategy that enables safety communication to be delivered by the most appropriate method based on the individual’s role and need to receive safety related information. This may be done through safety newsletters, notices, bulletins, briefings or training courses. The safety manager should also ensure that lessons learned from investigations and case histories or experiences, both

internally and from other organisations, are distributed widely. Safety communication therefore aims to:

a) ensure that staff are fully aware of the SMS; this is a good way of promoting the organisation's safety policy and safety objectives.

b) convey safety-critical information; Safety critical information is specific information related to safety issues and safety risks that could expose the organisation to safety risk. This could be from safety information gathered from internal or external sources such as lessons learned or related to safety risk controls. The service provider determines what information is considered safety critical and the timeliness of its communication.

c) raise awareness of new safety risk controls and corrective actions; The safety risks faced by the service provider will change over time, and whether this is a new safety risk that has been identified or changes to safety risk controls, these changes will need to be communicated to the appropriate personnel.

d) provide information on new or amended safety procedures; when safety procedures are updated it is important that the appropriate people are made aware of these changes.

e) promote a positive safety culture and encourage personnel to identify and report hazards; safety communication is two-way. It is important that all personnel communicate safety issues to the organisation through the safety reporting system.

f) provide feedback; provide feedback to personnel submitting safety reports on what actions have been taken to address any concerns identified.

6.5.2 Service providers should consider whether any of the safety information listed above needs to be communicated to external organisations.

6.5.3 Service providers should assess the effectiveness of their safety communication by checking personnel have received and understood any safety critical information that has been distributed. This can be done as part of the internal audit activities or when assessing the SMS effectiveness.

6.5.4 Safety promotion activities should be carried out throughout the life cycle of the SMS, not only at the beginning.

7 Implementation Planning

7.1 System description

7.1.1 A system description helps to identify the organisational processes, including any interfaces, to define the scope of the SMS. This provides an opportunity to identify any gaps related to the service provider's SMS components and elements and may serve as a starting point to identify organisational and operational hazards. A system description serves to identify the features of the product, the service or the activity so that SRM and safety assurance can be effective.

7.1.2 Most organisations are made up of a complex network of interfaces and interactions involving different internal departments as well as different external organisations that all contribute to the safe operation of the organisation. The use of a system description enables the organisation to have a clearer picture of its many interactions and interfaces. This will enable better management of safety risk and safety risk controls if they are described, and help in understanding the impact of changes to the SMS processes and procedures.

7.1.3 When considering a system description, it is important to understand that a "system" is a set of things working together as parts of an interconnecting network. In an SMS, it is any of an organisation's products, people, processes, procedures, facilities, services, and other aspects (including external factors), which are related to, and can affect, the organisation's aviation safety activities. Often, a "system" is a collection of systems, which may also be viewed as a system with subsystems. These systems and their interactions with one another make up the sources of hazards and contribute to the control of safety risks. The important systems include both those which could directly impact aviation safety and those which affect the ability or capacity of an organisation to perform effective safety management.

7.1.4 An overview of the system description and the SMS interfaces should be included in the SMS documentation. A system description may include a bulleted list with references to policies and procedures. A graphic depiction, such as a process flow chart or annotated organisation chart, may be enough for some organisations. An organisation should use a method and format that works for that organisation.

7.1.5 Because each organisation is unique, there is no "one size fits all" method for SMS implementation. It is expected that each organisation will implement an SMS that works for its unique situation. Each organisation should define for itself how it intends to go about fulfilling the fundamental requirements. To accomplish this, it is important that each organisation prepare a system description that identifies its organisational structures, processes, and business arrangements that it considers important to safety management functions. Based on the system description, the organisation should identify or develop policy, processes, and procedures that establish its own safety management requirements.

7.1.6 When an organisation elects to make a significant or substantive change to the processes identified in the system description, the changes should be viewed as potentially affecting its baseline safety risk assessment. Thus, the system description should be reviewed as part of the management of change processes.

7.2 Interface management

Safety risks faced by service providers are affected by interfaces. Interfaces can be either internal (e.g. between departments) or external (e.g. other service providers or contracted services,). By identifying and managing these interfaces the service provider will have more control over any safety risks related to the interfaces. These interfaces should be defined within the system description.

7.3 Identification of SMS interfaces

7.3.1 Initially service providers should concentrate on interfaces in relation to its business activities. The identification of these interfaces should be detailed in the system description that sets out the scope of the SMS and should include internal and external interfaces.

7.3.2 Figure 7-1 is an example of how a service provider could map out the different organisations it interacts with to identify any SMS interfaces. The objective of this review is to produce a comprehensive list of all interfaces. The rationale for this exercise is that there may be SMS interfaces which an organisation is not necessarily fully aware of. There may be interfaces where there are no formal agreements in place, such as with the power supply or building maintenance companies.

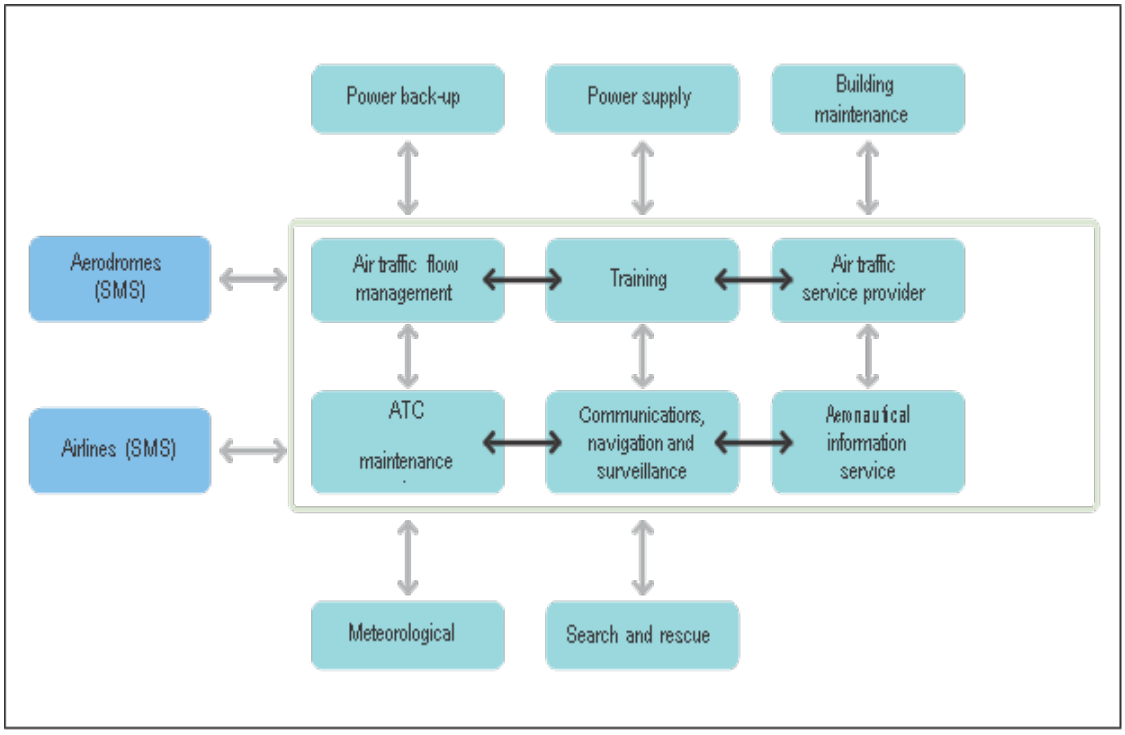

Figure 7-1: Example of air traffic service provider SMS interfaces

7.3.3 Some of the internal interfaces may be with business areas not directly associated with safety, such as marketing, finance, legal and human resources. These areas can impact safety through their decisions which impact on internal resources and investment, as well as through agreements and contracts with external organisations, and may not necessarily address safety.

7.3.4 Once the SMS interfaces have been identified, the service provider should consider their relative criticality. This enables the service provider to prioritize the management of the more critical interfaces, and their potential safety risks. Things to consider are:

a) what is being provided;

b) why it is needed;

c) whether the organisations involved has an SMS or another management system in place; and

d) whether the interface involves the sharing of safety data / information

Assessing safety impact of interfaces

7.3.5 The service provider should then identify any hazards related to the interfaces and carry out a safety risk assessment using its existing hazard identification and safety risk assessment processes.

7.3.6 Based on the safety risks identified, the service provider may consider working with the other organisation to determine and define an appropriate safety risk control strategy. By involving the other organisation, they may be able to contribute to identifying hazards, assessing the safety risk as well as determining the appropriate safety risk control. This collaborative effort is needed because the perception of safety risks may not be the same for each organisation. The risk control could be carried out by either the service provider or the external organisation.

7.3.7 It is also important to recognize that each organisation involved has the responsibility to identify and manage hazards that affect their own organisation. This may mean the critical nature of the interface is different for each organisation as they may apply different safety risk classifications and have different safety risk priorities (in term of safety performance, resources, time, etc.).

Managing and monitoring interfaces

7.3.8 The service provider is responsible for managing and monitoring the interfaces to ensure the safe provision of their services and products. This will ensure the interfaces are managed effectively and remain current and relevant. Formal agreements are an effective way to accomplish this as the interfaces and associated responsibilities can be clearly defined. Any changes in the interfaces and associated impacts should be communicated to the relevant organisations.

7.3.9 Challenges associated with the service provider's ability to manage interface safety risks include:

a) one organisation's safety risk controls are not compatible with the other organisations';

b) willingness of both organisations to accept changes to their own processes and procedures;

c) insufficient resources or technical expertise available to manage and monitor the interface; and

d) number and location of interfaces.

7.3.10 It is important to recognize the need for coordination between the organisations involved in the interface. Effective coordination should include:

a) clarification of each organisation's roles and responsibilities;

b) agreement of decisions on the actions to be taken (e.g. safety risk control actions and timescales);

c) identification of what safety information needs to be shared and communicated;

d) how and when coordination should take place (task force, regular meetings, ad hoc or dedicated meetings); and

e) agreeing on solutions that benefit both organisations but that do not impair the effectiveness of the SMS.

7.3.11 All safety issues or safety risks related to the interfaces should be documented and made accessible to each organisation for sharing and review. This will allow the sharing of lessons learned and the pooling of safety data that will be valuable for both organisations. Operational safety benefits may be achieved through an enhancement of safety reached by each organisation as the result of shared ownership of safety risks and responsibility.

7.4 SMS scalability

7.4.1 The organisation's SMS, including the policies, processes and procedures, should reflect the size and complexity of the organisation and its activities. It should consider:

a) the organisational structure and availability of resources;

b) size and complexity of the organisation (including multiple sites and bases); and

c) complexity of the activities and the interfaces with external organisations.

7.4.2 The service provider should carry out an analysis of its activities to determine the right level of resources to manage the SMS. This should include the determination of the organisational structure needed to manage the SMS. This would include considerations of who will be responsible for managing and maintaining the SMS, what safety committees are needed, if any, and the need for specific safety specialists.

Safety risk considerations

7.4.3 Regardless of the size of the service provider, scalability should also be a function of the inherent safety risk of the service provider's activities. Even small organisations may be involved in activities that may entail significant aviation safety risks. Therefore, safety management capability should be commensurate with the safety risk to be managed.

Safety data and safety information and its analysis

7.4.4 For small organisations, the low volume of data may mean that it is more difficult to identify trends or changes in the safety performance. This may require meetings to raise and discuss safety issues with appropriate experts. This may be more qualitative than quantitative but will help identify hazards and risks for the service provider. Collaborating with other service providers or industry associations can be helpful, since these may have data that the service provider does not have. For example, smaller service providers can exchange with similar organisations/operations to share safety risk information and identify safety performance trends. Service providers should adequately analyse and process their internal data even though it may be limited.

7.4.5 Service providers with many interactions and interfaces will need to consider how they gather safety data and safety information from multiple organisations. This may result in large volumes of data being collected to be collated and analysed later. These service providers should utilise an appropriate method of managing such data. Consideration should also be given to the quality of the data collected and the use of taxonomies to help with the analysis of the data.

7.5 Integration of management systems

7.5.1 Safety management should be considered as part of a management system (and not in isolation). Therefore, a service provider may implement an integrated management system that includes the SMS. An integrated management system may be used to capture multiple certificates, authorisations or approvals or to cover other business management systems such as quality, security, occupational health and environmental management systems. This is done to remove duplication and exploit synergies by managing safety risks across multiple activities. For example, where a service provider holds multiple certificates it may choose to implement a single management system to cover all of its activities. The

service provider should decide the best means to integrate or segregate its SMS to suit its business or organisational needs.

7.5.2 A typical integrated management system may include a:

a) quality management system (QMS);

b) safety management system (SMS);

c) security management system (SeMS), further guidance may be found in the Aviation Security Manual (Doc 8973 — Restricted);

d) environmental management system (EMS);

e) occupational health and safety management system (OHSMS);

f) financial management system (FMS);

g) documentation management system (DMS); and

h) fatigue risk management system (FRMS).

7.5.3 A service provider may choose to integrate these management systems based on their unique needs. Risk management processes and internal audit processes are essential features of most of these management systems. It should be recognized that the risks and risk controls developed in any of these systems could have an impact on other systems. In addition, there may be other operational systems associated with the business activities that may also be integrated, such as supplier management, facilities management, etc.

7.5.4 A service provider may also consider applying the SMS to other areas that do not have a current regulatory requirement for an SMS. Service providers should determine the most suitable means to integrate or segregate their management system to suit their business model, operating environment, regulatory, and statutory requirements as well as the expectations of the aviation community. Whichever option is taken, it should still ensure that it meets the SMS requirements.

Benefits and challenges of management system integration

7.5.5 Integrating the different areas under a single management system will improve efficiency by:

a) reducing duplication and overlapping of processes and resources;

b) reducing potentially conflicting responsibilities and relationships;

c) considering the wider impacts of risks and opportunities across all activities; and

d) allowing effective monitoring and management of performance across all activities.

7.5.6 Possible challenges of management system integration include:

a) existing systems may have different functional managers who resist the integration; this could result in conflict;

b) there may be resistance to change for personnel impacted by the integration as this will require greater cooperation and coordination;

c) impact on the overall safety culture within the organisation as there may be different cultures in respect of each system; this could create conflicts;

d) regulations may prevent such an integration or the different regulators and standards bodies may have diverging expectations on how their requirements should be met; and

e) integrating different management systems (such as QMS and SMS) may create additional work to be able to demonstrate that the separate requirements are being met.

7.5.7 To maximize the benefits of integration and address the related challenges, senior management commitment and leadership is essential to manage the change effectively. It is important to identify the person who has overall responsibility for the integrated management system.

7.6 SMS and QMS Integration

7.6.1 Some service providers have both an SMS and QMS. These sometimes are integrated into a single management system. The QMS is generally defined as the organisational structure and associated accountabilities, resources, processes and procedures necessary to establish and promote a system of continuous quality assurance and improvement while delivering a product or service.

7.6.2 Both systems are complementary; the SMS focuses on managing safety risks and safety performance while the QMS focuses on compliance with prescriptive regulations and requirements to meet customer expectations and contractual obligations. The objectives of an SMS are to identify hazards, assess the associated safety risk and implement effective safety risk controls. In contrast, the QMS focuses on the consistent delivery of products and services that meet relevant specifications. Nonetheless, both the SMS and the QMS:

a) should be planned and managed;

b) involve all organisational functions related to the delivery of aviation products and services;

c) identify ineffective processes and procedures;

d) strive for continuous improvement; and

e) have the same goal of providing safe and reliable products and services to customers.

7.6.3 The SMS focuses on:

a) identification of safety-related hazards facing the organisation;

b) assessment of the associated safety risk;

c) implementation of effective safety risk controls to mitigate safety risks;

d) measuring safety performance; and

e) maintaining an appropriate resource allocation to meet safety performance requirements.

7.6.4 The QMS focuses on:

a) compliance with regulations and requirements;

b) consistency in the delivery of products and services;

c) meeting the specified performance standards; and

d) delivery of products and services that are “fit for purpose” and free of defects or errors.

7.6.5 Monitoring compliance with regulations is necessary to ensure that safety risk controls, applied in the form of regulations, are effectively implemented and monitored by the service provider. The causes and contributing factors of any non-compliance should also be analysed and addressed.

7.6.6 Given the complementary aspects of SMS and QMS, it is possible to integrate both systems without compromising each function. This can be summarized as follows:

a) an SMS is supported by QMS processes such as auditing, inspection, investigation, root cause analysis, process design, and preventive actions;

b) a QMS may identify safety issues or weaknesses in safety risk controls;

c) a QMS may foresee safety issues that exist despite the organisation’s compliance with standards and specifications;

d) quality principles, policies and practices should be aligned with the objectives of safety management; and

e) QMS activities should consider identified hazards and safety risk controls for the planning and performance of internal audits.

7.6.7 In conclusion, in an integrated management system with unified goals and decision-making that considers the wider impacts across all activities, quality management and safety management processes will be highly complementary and will support the achievement of the overall safety goals.

7.7 SMS gap analysis and implementation

7.7.1 Before implementing an SMS, the service provider should carry out a gap analysis. This compares the service provider's existing safety management processes and procedures with the SMS requirements. It is likely that the service provider already has some of the SMS functions in place. The development of an SMS should build upon existing organisational policies and processes. The gap analysis identifies the gaps that should be addressed through an SMS implementation plan that defines the actions needed to implement a fully functioning and effective SMS.

7.7.2 The SMS implementation plan should provide a clear picture of the resources, tasks and processes required to implement the SMS. The timing and sequencing of the implementation plan may depend on a variety of factors that will be specific to each organisation, such as:

a) regulatory, customer and statutory requirements;

b) multiple certificates held (with possibly different regulatory implementation dates);

c) the extent to which the SMS may build upon existing structures and processes;

d) the availability of resources and budgets;

e) interdependencies between different steps (a reporting system should be implemented before establishing a data analysis system); and

f) the existing safety cultures.

7.7.3 The SMS implementation plan should be developed in consultation with the accountable executive and other senior managers, and should include who is responsible for the actions along with timelines. The plan should address coordination with external organisations or contractors where applicable.

7.7.4 The SMS implementation plan may be documented in different forms, varying from a simple spread sheet to specialized project management software. The plan should be monitored regularly and updated as necessary. It should also clarify when a specific element can be considered successfully implemented.

7.8 Phased Implementation Approach

7.8.1 General

7.8.1.1 The objective of this section is to introduce an example of the four SMS implementation phases. The implementation of an SMS is a systematic process. Nevertheless, this process may be quite a challenging task depending on factors, such as the availability of guidance material and resources required for implementation, as well as the service provider's pre-existing knowledge of SMS processes and procedures.

7.8.1.2 The reasons for a phased approach to SMS implementation include:

a) the provision of a manageable series of steps to follow in implementing an SMS, including allocation of resources;

b) the need to allow implementation of SMS framework elements in various sequences, depending upon the results of each service provider's gap analysis;

c) the initial availability of data and analytic processes to support reactive, proactive and predictive safety management practices; and

d) the need for a methodical process to ensure effective and sustainable SMS implementation.

7.8.1.3 The phased approach recognizes that implementation of a fully mature SMS is a multi-year process. A phased implementation approach permits the SMS to become more robust as each implementation phase is completed. Fundamental safety management processes are completed before moving to successive phases involving processes of greater complexity.

7.8.1.4 Four implementation phases are proposed for an SMS. Each phase is associated with various elements (or sub-elements) as per the ICAO SMS framework. It is apparent that the particular configuration of elements in this guidance material is not meant to be absolute. Service providers may choose to make adjustments as may be deemed appropriate for the circumstances. A summary of the four phases of SMS implementation and their corresponding elements is shown in Table 7-1.

Phase 1 (12 months)*	*Phase 2 (12 months)*	*Phase 3 (18 months)*	*Phase 4 (18 months)*
1. SMS Element 1.1 (i): a) identify the SMS accountable executive; b) establish an SMS implementation team; c) define the scope of the SMS; d) perform an SMS gap analysis. 2. SMS Element 1.5 (i): a) develop an SMS implementation plan. 3. SMS Element 1.3: a) establish a key person/office responsible for the administration and maintenance of the SMS. 4. SMS Element 4.1 (i): a) establish an SMS training programme for personnel, with priority for the SMS implementation team. 5. SMS Element 4.2 (i): a) initiate SMS/ safety communication channels.	1. SMS Element 1.1 (ii): a) establish the safety policy andobjectives, 2. SMS Element 1.2: a) define safety management responsibilities and accountabilities across relevant departments of theorganisation; b) establish an SMS/safety coordination mechanism/ committee; c) establish departmental/ divisional SAGs where applicable. 3. SMS Element 1.4: a) establish an emergency response plan. 4. SMS Element 1.5 (ii): a) initiate progressive development of an SMS document/manual and other supporting documentation.	1. SMS Element 2.1 (i): a) establish a voluntary hazard reporting procedure. 2. SMS Element 2.2: a) establish safety risk management procedures. 3. SMS Element 3.1 (i): a) establish occurrence reporting and investigation procedures; b) establish a safety data collection and processing system for high-consequence outcomes; c) develop high-consequence SPIs and associated targets and alert settings. 4. SMS Element 3.2: a) establish a management of change procedure that includes safety risk assessment. 5. SMS Element 3.3 (i): a) establish an internal quality audit programme; b) establish an external quality audit programme.	1. SMS Element 1.1 (iii): a) enhance the existing disciplinary procedure/ policy with due consideration of unintentional errors or mistakes from deliberate or gross violations. 2. SMS Element 2.1 (ii): a) integrate hazards identified from occurrence investigation reports with the voluntary hazard reporting system; b) integrate hazard identification and risk management procedures with the subcontractor's or customer's SMS where applicable. 3. SMS Element 3.1 (ii): a) enhance the safety data collection and processing system to include lower-consequence events; b) develop lower-consequence SPIs and associated targets/ alert settings. 4. SMS Element 3.3 (ii): a) establish SMS audit programmes or integrate them into existing internal andexternal audit programmes; b) establish other operational SMS review/survey programmes where appropriate. 5. SMS Element 4.1 (ii): a) ensure that the SMS training programme for all relevant personnel has been completed. 6. SMS Element 4.2 (ii): a) promote safety information sharing and exchange internally and externally.
SMS Element 1.5: SMS documentation (Phases 1 to 4) >>>			
SMS Elements 4.1 and 4.2: SMS training, education and communication (Phases 1 and thereafter) >>			
Note 1. — The implementation period indicated is an approximation. The actual implementation period is dependent on the scope of actions required for each element allocated and the size/complexity of the organisation. *Note 2. — The SMS element numbers indicated correspond to the ICAO SMS element numbers. Suffixes such as a), b) and c) indicate that the element has been subdivided to facilitate the phased implementation approach.*			

Table 7-1: Four phases of SMS implementation

7.8.2 Phase 1

7.8.2.1 The objective of Phase 1 of SMS implementation is to provide a blueprint of how the SMS requirements will be met and integrated into the organisation's control systems, as well as an accountability framework for the implementation of the SMS.

7.8.2.2 During Phase 1, basic planning and assignment of responsibilities are established. Central to Phase 1 is the gap analysis. From the gap analysis, an organisation can determine the status of its existing safety management processes and can begin planning for the development of further safety management processes. The significant output of Phase 1 is the SMS implementation plan.

7.8.2.3 At the completion of Phase 1, the following activities should be finalized in such a manner that meets the expectations of the civil aviation oversight authority, as set forth in relevant requirements and guidance material:

Management commitment and responsibility — Element 1.1 (i)

a) Identify the accountable executive and the safety accountabilities of managers. This activity is based on Elements 1.1 and 1.2 of the ICAO SMS framework.

b) Establish an SMS implementation team. The team should be comprised of representatives from the relevant departments. The team's role is to drive the SMS implementation from the planning stage to its final implementation. Other functions of the implementation team will include but not be limited to:

1) developing the SMS implementation plan;

2) ensuring the adequate SMS training and technical expertise of the team in order to effectively implement the SMS elements and related processes; and

3) monitoring of and reporting on the progress of the SMS implementation, providing regular updates and coordinating with the SMS accountable executive.

c) Define the scope of the organisation's activities (departments/ divisions) to which the SMS will be applicable. The scope of the organisation's SMS applicability will subsequently need to be described in the SMS document as appropriate. This activity is based on Element 1.5 of the ICAO SMS framework. Guidance on the system description is provided in Chapter 7.1 of this CAGM.

d) Conduct a gap analysis of the organisation's current systems and processes in relation to the ICAO SMS framework requirements (or the

relevant SMS regulatory requirements). Guidance on an SMS gap analysis and implementation plan is provided in Appendix 4 of this CAGM.

SMS implementation plan — Element 1.5 (i)

a) Develop an SMS implementation plan on how the organisation will implement the SMS on the basis of the identified system and process gaps resulting from the gap analysis. An example of a basic SMS implementation plan is provided in Appendix 7 to this Chapter.

Appointment of key safety personnel — Element 1.3

a) Identify the key SMS person (safety/quality function) within the organisation who will be responsible foradministering the SMS on behalf of the accountable executive.

b) Establish the safety services office.

Training and education — Element 4.1 (i)

a) Conduct a training needs analysis.

b) Organise and set up schedules for appropriate training of all staff according to their individual responsibilities and involvement in the SMS.

c) Develop safety training considering:

   1) initial (general safety) job-specific training; and

   2) recurrent training.

d) Identify the costs associated with training.

e) Develop a validation process that measures the effectiveness of training.

f) Establish a safety training records system.

Safety communication — Element 4.2 (i)

a) Initiate a mechanism or medium for safety communication.

b) Establish a means to convey safety information through any of:

   1) safety newsletters, notices and bulletins;

   2) websites;

   3) email.

7.8.3 Phase 2

The objective of Phase 2 is to implement essential safety management processes, while at the same time correcting potential deficiencies in existing safety management processes. Most organisations will have some basic safety management activities in place at different levels of implementation. This phase aims at consolidating existing activities and developing those which do not yet exist.

Management commitment and responsibility — Element 1.1 (ii)

a) Develop a safety policy.

b) Have the accountable executive sign the safety policy.

c) Communicate the safety policy throughout the organisation.

d) Establish a review schedule for the safety policy to ensure it remains relevant and appropriate to the organisation.

e) Establish safety objectives for the SMS by developing safety performance standards in terms of:

   1) safety performance indicators;

   2) safety performance targets and alert levels; and

   3) action plans.

f) Establish the SMS requirements for subcontractors:

   1) establish a procedure to write SMS requirements into the contracting process; and

   2) establish the SMS requirements in the bidding documentation.

Safety accountabilities — Element 1.2

a) Define safety accountabilities and communicate them throughout the organisation.

b) Establish the safety action group (SAG).

c) Establish the safety/SMS coordination committee.

d) Define clear functions for the SAG and the safety/SMS coordination committee.

e) Establish lines of communication between the safety services office, the accountable executive, the SAG and the safety/SMS coordination committee.

f) Appoint the accountable executive as the chairperson of the safety/SMS coordination committee.

g) Develop a schedule of meetings for the safety services office to meet with the safety/SMS coordination committee and SAG as needed.

Coordination of emergency response planning — Element 1.4

a) Review the outline of the ERP related to the delegation of authority and assignment of emergency responsibilities.

b) Establish coordination procedures for action by key personnel during the emergency and the return to normal operations.

c) Identify external entities that will interact with the organisation during emergency situations.

d) Assess the respective ERPs of the external entities.

e) Establish coordination between the different ERPs.

f) Incorporate information about the coordination between the different ERPs in the organisation's SMS documentation.

SMS documentation — Element 1.5 (ii)

a) Create an SMS documentation system to describe, store, retrieve and archive all SMS-related information and records by:

1) developing an SMS document that is either a stand-alone manual or a distinct section within an existing controlled organisation manual (refer to Appendix 2 for guidance on developing an SMS manual);

2) establishing an SMS filing system to collect and maintain current records relating to the organisation's ongoing SMS processes;

3) maintaining records to provide a historical reference as well as the current status of all SMS processes such as: a hazard register; an index of completed safety assessments; SMS/safety training records; current SPIs and associated safety objectives; internal SMS audit reports; SMS/safety committee meeting minutes and the SMS implementation plan;

4) maintaining records that will serve as evidence of the SMS operation and activities during internal or external assessment or audit of the SMS.

7.8.4 Phase 3

The objective of Phase 3 is to establish safety risk management processes. Towards the end of Phase 3, the organisation will be ready to collect safety data and perform safety analyses based on information obtained through the various reporting systems.

Hazard identification — Element 2.1 (i)

a) Establish a voluntary reporting procedure. Refer to Appendix 5 for guidance.

b) Establish a programme/schedule for systematic review of all applicable aviation safety-related processes/equipment that are eligible for the HIRM process.

c) Establish a process for prioritization and assignment of identified hazards for risk mitigation.

Safety risk assessment and mitigation — Element 2.2

a) Establish a safety risk management procedure, including its approval and periodic review process.

b) Develop and adopt safety risk matrices relevant to the organisation's operational or production processes.

c) Include adopted safety risk matrices and associated instructions in the organisation's SMS or risk management training material.

Safety performance monitoring and measurement — Element 3.1 (i)

a) Establish an internal occurrence reporting and investigation procedure. This may include mandatory or major defect reports (MDR) where applicable.

b) Establish safety data collection, processing and analysis of high-consequence outcomes.

c) Establish high consequence safety indicators (initial ALoSP) and their associated target and alert settings. Examples of high-consequence safety indicators are accident rates, serious incident rates and monitoring of high-risk non-compliance outcomes. Refer to Chapter 10 of this CAGM for guidance on safety performance indicators.

d) Reach an agreement with the CAAM on safety performance indicators and safety performance targets.

The management of change — Element 3.2

a) Establish a formal process for the management of change that considers:

   1) the vulnerability of systems and activities;

   2) the stability of systems and operational environments;

   3) past performance;

   4) regulatory, industry and technological changes.

b) Ensure that management of change procedures address the impact on existing safety performance and risk mitigation records before implementing new changes.

c) Establish procedures to ensure that safety assessment of new aviation safety-related operations, processes and equipment are conducted (or accounted for) as applicable, before they are commissioned.

Continuous improvement of the SMS — Element 3.3 (i)

a) Develop forms for internal evaluations.

b) Define an internal audit process.

c) Define an external audit process.

d) Define a schedule for evaluation of facilities, equipment, documentation and procedures to be completed through audits and surveys.

e) Develop documentation relevant to operational safety assurance.

7.8.5 Phase 4

Phase 4 is the final phase of SMS implementation. This phase involves the mature implementation of safety risk management and safety assurance. In this phase operational safety assurance is assessed through the implementation of periodic monitoring, feedback and continuous corrective action to maintain the effectiveness of safety risk controls.

Management commitment and responsibility — Element 1.1 (iii)

a) Enhance the existing disciplinary procedure/policy with due consideration of unintentional errors/mistakes from deliberate/gross violations.

Hazard identification — Element 2.1 (ii)

a) Integrate the hazards identified from occurrence investigation reports with the voluntary reporting system.

b) Integrate hazard identification and risk management procedures with the subcontractor or customer SMS where applicable.

c) If necessary, develop a process for prioritizing collected hazards for risk mitigation based on areas of greater need or concern.

Safety performance monitoring and measurement — Element 3.1 (ii)

a) Enhance the safety data collection and processing system to include lower-consequence events.

b) Establish lower-consequence safety/quality indicators with target/alert level monitoring as appropriate (mature ALoSP).

c) Reach an agreement with the CAAM on lower-consequence safety performance indicators and safety performance target/alert levels.

Continuous improvement of the SMS — Element 3.3 (ii)

a) Establish SMS audits or integrate them into existing internal and external audit programmes.

b) Establish other operational SMS review/survey programmes where appropriate.

Training and education — Element 4.1 (ii)

a) Complete an SMS training programme for all relevant personnel.

Safety communication — Element 4.2 (ii)

a) Establish mechanisms to promote safety information sharing and exchange internally and externally.

7.8.6 SMS elements progressively implemented throughout Phases 1 to 4

In the phased approach implementation, the following three key elements are progressively implemented throughout each phase:

SMS documentation — Element 1.5

As the SMS progressively matures the relevant SMS manual and safety documentation must be revised and updated accordingly. This activity will be inherent to all phases of SMS implementation and must be maintained after implementation as well.

Training and education — Element 4.1 and Safety communication — Element 4.2

As with SMS documentation, training, education and safety communication are important ongoing activities throughout all phases of SMS implementation. As the SMS evolves, new processes, procedures or regulations may come into effect or existing procedures may change to cater for the SMS requirements. To ensure these changes are effectively understood and implemented by all personnel involved in safety- related duties it is vital that training and communication remain as ongoing activities throughout and after the complete implementation of the SMS.

8 Safety Risk Management

Safety Risk Management (SRM) is a key component of safety management and includes hazard identification, safety risk assessment, safety risk mitigation and risk acceptance. SRM is a continuous activity because the aviation system is constantly changing, new hazards can be introduced and some hazards and associated safety risks may change over time. In addition, the effectiveness of implemented safety risk mitigation strategies must be monitored to determine if further action is required.

8.1 Introduction to hazards

8.1.1 In aviation, a hazard can be considered as a dormant potential for harm which is present in one form or another within the system or its environment. This potential for harm may appear in different forms, for example: as a natural condition (e.g. terrain) or technical status (e.g. runway markings).

8.1.2 Hazards are an inevitable part of aviation activities; however, their manifestation and possible adverse consequences can be addressed through mitigation strategies which aim to contain the potential for the hazard to result in an unsafe condition. Aviation can coexist with hazards so long as they are 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

8.2 Understanding hazards and their consequences

8.2.1 Hazard identification focuses on conditions or objects that could cause or contribute to the unsafe operation of aircraft or aviation safety-related equipment, products and services (guidance on distinguishing hazards that are directly pertinent to aviation safety from other general/industrial hazards is addressed in subsequent paragraphs).

8.2.2 Consider, for example, a fifteen-knot wind. Fifteen-knots of wind is not necessarily a hazardous condition. In fact, a fifteen-knot wind blowing directly down the runway improves aircraft take-off and landing performance. But if the fifteen-knot wind is blowing across the runway, a crosswind condition is created which may be hazardous to operations. This is due to its potential to contribute to aircraft instability. The reduction in control could lead to an occurrence, such as a lateral runway excursion.

8.2.3 It is not uncommon for people to confuse hazards with their consequences. A consequence is an outcome that can be triggered by a hazard. 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.

8.2.4 In the crosswind example above, an immediate outcome of the hazard could be loss of lateral control followed by a consequent runway excursion. The ultimate consequence could be an accident. The damaging potential of a hazard can materialize through one or many consequences. It is important that safety risk assessments identify all of the possible consequences. The most extreme consequence - loss of human life - should be differentiated from those that involve lesser consequences, such as: aircraft incidents; increased flight crew workload; or passenger discomfort. The description of the consequences will inform the risk assessment and subsequent development and implementation of mitigations through prioritization and allocation of resources. Detailed and thorough hazard identification will lead to more accurate assessment of safety risks.

Hazard identification and prioritisation

8.2.5 Hazards exist at all levels in the organisation and are detectable through many sources including reporting systems, inspections, audits, brainstorming sessions and expert judgement. The goal is to proactively identify hazards before they lead to accidents, incidents or other safety-related occurrences. An important mechanism for proactive hazard identification is a voluntary safety reporting system. Information collected through such reporting systems may be supplemented by observations or findings recorded during routine site inspections or organisational audits.

8.2.6 Hazards can also be identified in the review or study of internal and external investigation reports. A consideration of hazards when reviewing accident or incident investigation reports is a good way to enhance the organisation's hazard identification system. This is particularly important when the organisation's safety culture is not yet mature enough to support effective voluntary safety reporting, or in small organisations with limited events or reports. An important source of specific hazards linked to operations and activities is from external sources such as ICAO, trade associations or other international bodies.

8.2.7 Hazard identification may also consider hazards that are generated outside of the organisation and hazards that are outside the direct control of the organisation, such as extreme weather or volcanic ash. Hazards related to emerging safety risks are also an important way for organisations to prepare for situations that may eventually occur.

8.2.8 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) organisational 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 and 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 a deterioration of product reliability;

j) human-machine interface factors; and

k) factors related to the SMS interfaces with other service providers.

Occupational safety health and environmental (OSHE) hazards

8.2.9 Safety risks associated with compound hazards that simultaneously impact aviation safety as well as OSHE may be managed through separate (parallel) risk mitigation processes to address the separate aviation and OSHE consequences, respectively. Alternatively, an integrated aviation and OSHE risk mitigation system may be used to address compound hazards. An example of a compound hazard is a lightning strike on an aircraft at an airport transit gate. This hazard may be deemed by an OSHE inspector to be a “workplace hazard” (ground personnel/workplace safety). To an aviation safety inspector, it is also an aviation hazard with risk of damage to the aircraft and a risk to passenger safety. It is important to consider both the OSHE and aviation safety consequences of such compound hazards, since they are not always the same. The purpose and focus of preventive controls for OSHE and aviation safety consequences may differ.

Hazard identification methodologies

8.2.10 The two main methodologies for identifying hazards are:

a) *Reactive*. This methodology involves 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 analysing 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) programmes, safety reporting systems and the safety assurance function.

8.2.11 Hazards can also be identified through safety data analysis which identifies adverse trends and makes predictions about emerging hazards, etc.

Hazards related to SMS interfaces with external organisations

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

8.2.13 As an example, an aircraft turnaround involves many organisations 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.

8.3 Safety risk probability

8.3.1 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?

8.3.2 Taking into consideration any factors that might underlie these questions will help when assessing the probability of the hazard consequences in any foreseeable scenario.

8.3.3 An occurrence is considered foreseeable if any reasonable person could have expected the kind of occurrence to have happened under the same circumstances. Identification of every conceivable or theoretically possible hazard is not possible. Therefore, good judgment is required to determine an appropriate level of detail in hazard identification. Service providers should exercise due diligence when

identifying significant and reasonably foreseeable hazards related to their product or service.

Note. — Regarding product design, the term "foreseeable" is intended to be consistent with its use in airworthiness regulations, policy, and guidance.

8.3.4 Table 8-1 presents a typical safety risk probability classification table. It includes five categories to denote the probability related to an unsafe event or condition, the description of each category, and an assignment of a value to each category. This example uses qualitative terms; quantitative terms could be defined to provide a more accurate assessment. This will depend on the availability of appropriate safety data and the sophistication of the organisation and operation.

Likelihood	*Meaning*	*Value*
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Improbable	Very unlikely to occur (not known to have occurred)	2
Extremely improbable	Almost inconceivable that the event will occur	1

Table 8-1: Safety risk probability table

8.4 Safety risk severity

8.4.1 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 severity classification should consider:

a) fatalities or serious injury which would occur as a result of:

   1) being in the aircraft;
   2) having direct contact with any part of the aircraft, including parts which have become detached from the aircraft; or
   3) having direct exposure to jet blast; and

b) damage:

   1) damage or structural failure sustained by the aircraft which:

      i) adversely affects the structural strength, performance or flight characteristics of the aircraft;
      ii) would normally require major repair or replacement of the affected component;

2) damage sustained by ATS or aerodrome equipment which:

i) adversely affects the management of aircraft separation; or
ii) adversely affects landing capability.

8.4.2 The severity assessment should consider all possible consequences related to a hazard, taking into account the worst foreseeable situation. Table 8-2 presents a typical safety risk severity table. It includes five categories to denote the level of severity, the description of each category, and the assignment of a value to each category. As with the safety risk probability table, this table is an example only.

Severity	*Meaning*	*Value*
Catastrophic	• Aircraft / equipment destroyed • Multiple deaths	A
Hazardous	• A large reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage	B
Major	• 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 • Serious incident • Injury to persons	C
Minor	• Nuisance • Operating limitations • Use of emergency procedures • Minor incident	D
Negligible	• Few consequences	E

Table 8-2: Example of safety risk severity table

8.5 Safety risk tolerability

8.5.1 The safety risk index rating is created by combining the results of the probability and severity scores. In the example above, it is an alphanumeric designator. The respective severity/probability combinations are presented in the safety risk assessment matrix in Table 8-3. The safety risk assessment matrix is used to determine safety risk tolerability. Consider, for example, a situation where the safety risk probability has been assessed as Occasional (4), and the safety risk severity has been assessed as Hazardous (B), resulting in a safety risk index of (4B).

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 8-3: Example of safety risk matrix

Note. — In determining the safety risk tolerability, the quality and reliability of the data used for the hazard identification and safety risk probability should be taken into consideration.

8.5.2 The index obtained from the safety risk assessment matrix should then be exported to a safety risk tolerability table that describes — in a narrative form — the tolerability criteria for the particular organisation. Table 8-4 presents an example of a safety risk tolerability table. Using the example above, 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 organisation should therefore take risk control action to reduce:

a) the organisation’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.

8.5.3 Safety risks are conceptually assessed as acceptable, tolerable or intolerable. Safety risks assessed as initially falling in the intolerable region are unacceptable under any circumstances. The probability and/or severity of the consequences of the hazards are of such a magnitude, and the damaging potential of the hazard poses such a threat to safety, that mitigation action is required or activities are stopped.

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. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	TOLERABLE	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk.
3E, 2D, 2E, 1B, 1C, 1D, 1E	ACCEPTABLE	Acceptable as is. No further safety risk mitigation required.

Table 8-4: Example of safety risk tolerability

8.6 Assessing human factors related risks

8.6.1 The consideration of human factors has particular importance in SRM as people can be both a source and a solution of safety risks by:

a) contributing to an accident or incident through variable performance due to human limitations;

b) anticipating and taking appropriate actions to avoid a hazardous situation: and

c) solving problems, making decisions and taking actions to mitigate risks.

8.6.2 It is therefore important to involve people with appropriate human factors expertise in the identification, assessment and mitigation of risks.

8.6.3 SRM requires all aspects of safety risk to be addressed, including those related to humans. Assessing the risks associated with human performance is more complex than risk factors associated with technology and environment since:

a) human performance is highly variable, with a wide range of interacting influences internal and external to the individual. Many of the effects of the interaction between these influences are difficult, or impossible to predict; and

b) the consequences of variable human performance will differ according to the task being performed and the context.

8.6.4 This complicates how the probability and the severity of the risk is determined. Therefore, human factors expertise is valuable in the identification and assessment of safety risks.

8.7 Safety risk mitigation strategies

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

8.7.2 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) 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.

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

8.7.3 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, this important human factors perspective results in more comprehensive and effective mitigations.

8.7.4 A safety risk mitigation strategy may involve one of the approaches described above or may include multiple approaches. It is important to consider the full range of possible control measures to find an optimal solution. The effectiveness of each alternative strategy must be evaluated before a decision is made. Each proposed safety risk mitigation alternative should be examined from the following perspectives:

a) *Effectiveness.* The extent to which the alternatives reduce or eliminate the safety risks. Effectiveness can be determined in terms of the technical, training and regulatory defences that can reduce or eliminate safety risks.

b) *Cost/benefit*. The extent to which the perceived benefits of the mitigation outweigh the costs.

c) *Practicality*. The extent to which mitigation can be implemented and how appropriate it is in terms of available technology, financial and administrative resources, legislation, political will, operational realities, etc.

d) *Acceptability*. The extent to which the alternative is acceptable to those people that will be expected to apply it.

e) *Enforceability*. The extent to which compliance with new rules, regulations or operating procedures can be monitored.

f) *Durability*. The extent to which the mitigation will be sustainable and effective.

g) *Residual safety risks*. The degree of safety risk that remains subsequent to the implementation of the initial mitigation and which may necessitate additional safety risk control measures.

h) *Unintended consequences*. The introduction of new hazards and related safety risks associated with the implementation of any mitigation alternative.

i) *Time*. Time required for the implementation of the safety risk mitigation alternative.

8.7.5 Corrective action should take into account any existing defences and their (in)ability to achieve an acceptable level of safety risk. This may result in a review of previous safety risk assessments that may have been impacted by the corrective action. Safety risk mitigations and controls will need to be verified/audited to ensure that they are effective. Another way to monitor the effectiveness of mitigations is through the use of SPIs. See Chapter 4 for more information on safety performance management and SPIs.

8.8 Safety risk management documentation

8.8.1 Safety risk management activities should be documented, including any assumptions underlying the probability and severity assessment, decisions made, and any safety risk mitigation actions taken. This may be done using a spread sheet or table. Some organisations may use a database or other software where large amounts of safety data and safety information can be stored and analysed.

8.8.2 Maintaining a register of identified hazards minimises the likelihood that the organisation will lose sight of its 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. Hazard registers are usually in a table format and typically include: the hazard, potential consequences, assessment of associated risks, identification date, hazard category, short description, when or where it applies, who identified it and what measure have been put in place to mitigate the risks.

8.8.3 Safety risk decision-making tools and processes can be used to improve the repeatability and justification of decisions taken by organisational safety decision makers. An example of a safety risk decision aid is provided below in Figure 8-1.

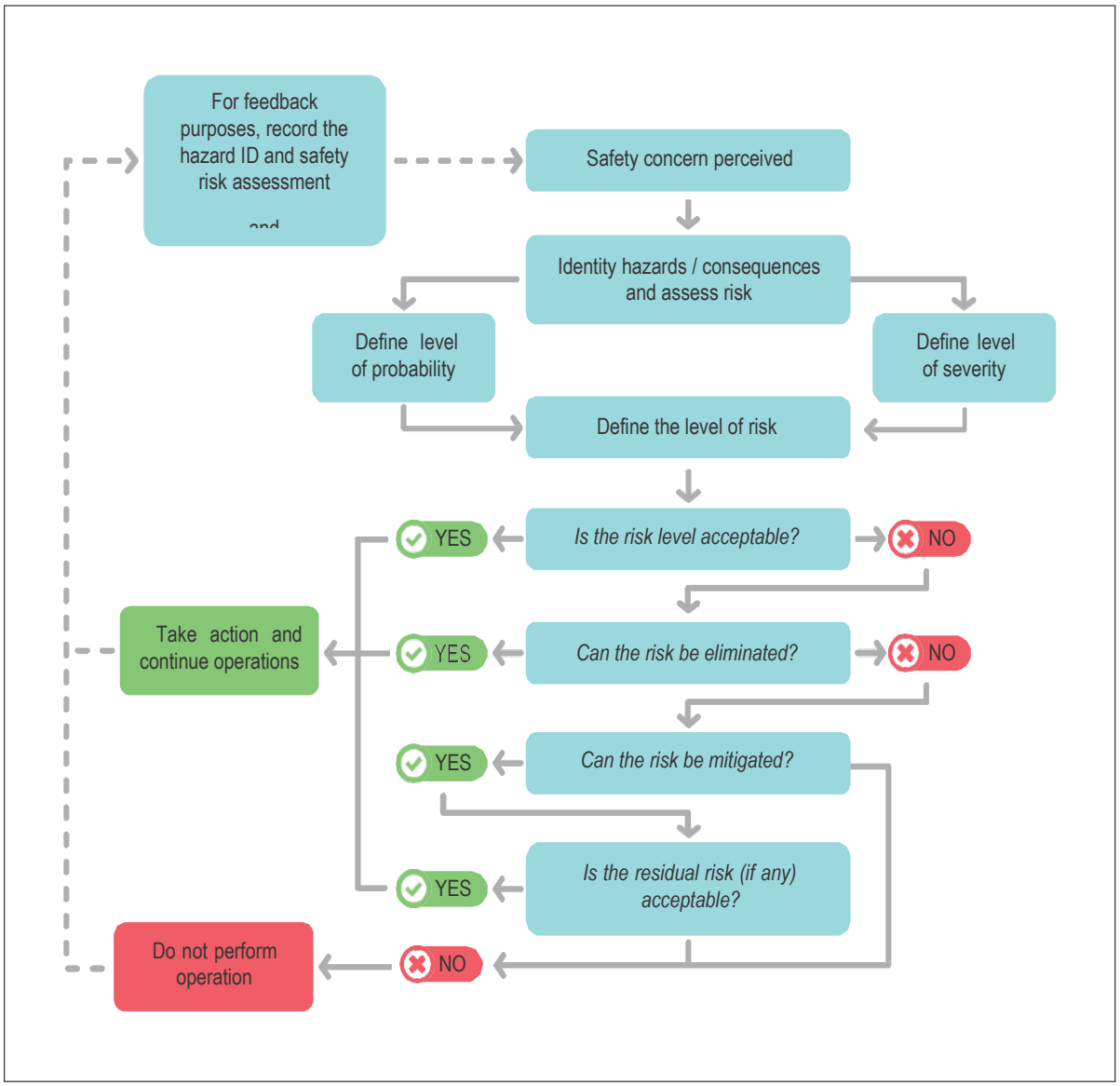

Figure 8-1: Safety risk management decision aid

8.9 Cost-benefit analysis

8.9.1 Cost-benefit or cost-effectiveness analysis is normally carried out during the safety risk mitigation activities. It is commonly associated with business management, such as a regulatory impact assessment or project management processes. However, there may be situations where a safety risk assessment may have a significant financial impact. In such situations, a supplementary cost-benefit analysis or cost-effectiveness process to support the safety risk assessment may be warranted. This will ensure cost-effectiveness analysis or justification of recommended safety risk control actions has been taken into consideration, with the associated financial implications.

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9 Hazard Taxonomies

9.1 Safety data should ideally be categorized using taxonomies and supporting definitions so that the data can be captured and stored using meaningful terms. Common taxonomies and definitions establish a standard language, improving the quality of information and communication. The aviation community's capacity to focus on safety issues is greatly enhanced by sharing a common language. Taxonomies enable analysis and facilitate information sharing and exchange. Some examples of taxonomies include:

a) Aircraft model: The organisation can build a database with all models certified to operate.

b) Airport: The organisation may use ICAO or International Air Transport Association (IATA) codes to identify airports.

c) Type of occurrence: An organisation may use taxonomies developed by ICAO and other international organisations to classify occurrences.

9.2 There are a number of industry common aviation taxonomies. Some examples include:

a) ADREP: an occurrence category taxonomy that is part of ICAO's accident and incident reporting system. It is a compilation of attributes and the related values that allow safety trend analysis on these categories.

b) Commercial Aviation Safety Team (CAST)/International Civil Aviation Organisation (ICAO) Common Taxonomy Team (CICTT): tasked with developing common taxonomies and definitions for aircraft accident and incident reporting systems.

c) Safety Performance Indicators Task Force (SPI-TF): tasked with developing globally harmonized metrics for service providers' SPIs as part of their SMS, to ensure uniformity in the collection of information and comparison of analysis results.

9.3 More examples of hazard taxonomies are provided in Appendix 7 of this CAGM.

9.4 Hazard taxonomies are especially important. Identification of a hazard is often the first step in the risk management process. Commencing with a commonly recognized language makes the safety data more meaningful, easier to classify and simpler to process. The structure of a hazard taxonomy may include a generic and specific component.

9.5 The generic component allows users to capture the nature of a hazard with a view to aid in identification, analysis, and coding. A high-level taxonomy of hazards has been developed by the CICTT which classifies hazards in families of hazard types (Environmental, Technical, Organisational, and Human).

9.6 The specific component adds precision to the hazard definition and context. This enables more detailed risk management processing. The following criteria may be helpful when formulating hazard definitions. When naming a hazard, it should be:

a) clearly identifiable;

b) described in the desired (controlled) state; and

c) identified using accepted names.

9.7 Common taxonomies may not always be available between databases. In such a case, data mapping should be used to allow the standardization of safety data and safety information based on equivalency. Using an aircraft type example, a mapping of the data could show that a “Boeing 787-8” in one database is equivalent with a “788” in another. This may not be a straightforward process as the level of detail during safety data and safety information capture may differ.

10 Safety Performance Indicators and Safety Performance Targets

10.1 Types of safety performance indicators

Qualitative and quantitative indicators

10.1.1 SPIs are used to help senior management know whether or not the organisation is likely to achieve its safety objective; they can be qualitative or quantitative. Quantitative indicators relate to measuring by the quantity, rather than its quality, whereas qualitative indicators are descriptive and measure by quality. Quantitative indicators are preferred over qualitative indicators because they are more easily counted and compared. The choice of indicator depends on the availability of reliable data that can be measured quantitatively. Does the necessary evidence have to be in the form of comparable, generalizable data (quantitative), or a descriptive image of the safety situation (qualitative)? Each option, qualitative or quantitative, involves different kinds of SPIs, and requires a thoughtful SPI selection process. A combination of approaches is useful in many situations, and can solve many of the problems which may arise from adopting a single approach. An example of a qualitative indicator for a service provider the assessment of the safety culture.

10.1.2 Quantitative indicators can be expressed as a number (x incursions) or as a rate (x incursions per n movements). In some cases, a numerical expression will be sufficient. However, just using numbers may create a distorted impression of the actual safety situation if the level of activity fluctuates. For example, if air traffic control records three altitude busts in July and six in August, there may be great concern about the significant deterioration in safety performance. But August may have seen double the movements of July meaning the altitude busts per movement, or the rate, has decreased, not increased. This may or may not change the level of scrutiny, but it does provide another valuable piece of information that may be vital to data-driven safety decision-making.

10.1.3 For this reason, where appropriate, SPIs should be reflected in terms of a relative rate to measure the performance level regardless of the level of activity. This provides a normalized measure of performance; whether the activity increases or decreases. As another example, an SPI could measure the number of runway incursions. But if there were fewer departures in the monitored period, the result could be misleading. A more accurate and valuable performance measure would be the number of runway incursions relative to the number of movements, e.g. x incursions per 1,000 movements.

Lagging and leading indicators

10.1.4 The two most common categories used by the service providers to classify their SPIs are lagging and leading. Lagging SPIs measure events that have already occurred. They are also referred to as “outcome-based SPIs” and are normally (but not always) the negative outcomes the organisation is aiming to avoid. Leading SPIs measure processes and inputs being implemented to improve or maintain safety. These are also known as “activity or process SPIs” as they monitor and measure conditions that have the potential to lead to or contribute to a specific outcome.

10.1.5 Lagging SPIs help the organisation understand what has happened in the past and are useful for long-term trending. They can be used as a high-level indicator or as an indication of specific occurrence types or locations, such as “types of accidents per aircraft type” or “specific incident types by region”. Because lagging SPIs measure safety outcomes, they can measure the effectiveness of safety mitigations. They are effective at validating the overall safety performance of the system. For example, monitoring the “number of ramp collisions per number of movements between vehicles following a redesign of ramp markings” provides a measure of the effectiveness of the new markings (assuming nothing else has changed). The reduction in collisions validates an improvement in the overall safety performance of the ramp system; which may be attributable to the change in question.

10.1.6 Trends in lagging SPIs can be analysed to determine conditions existing in the system that should be addressed. Using the previous example, an increasing trend in ramp collisions per number of movements may have been what led to the identification of sub-standard ramp markings as a mitigation.

10.1.7 Lagging SPIs are divided into two types:

a) *low probability/high severity*: outcomes such as accidents or serious incidents. The low frequency of high severity outcomes means that aggregation of data (at industry segment level or regional level) may result in more meaningful analyses. An example of this type of lagging SPI would be “aircraft and/or engine damage due to bird strike.

b) *high probability/low severity*: outcomes that did not necessarily manifest themselves in a serious accident or incident, these are sometimes also referred to as precursor indicators. SPIs for high probability/low severity outcomes are primarily used to monitor specific safety issues and measure the effectiveness of existing safety risk mitigations. An example of this type of precursor SPI would be “bird radar detections”, which indicates the level of bird activity rather than the amount of actual bird strikes.

10.1.8 Aviation safety measures have historically been biased towards SPIs that reflect “low probability/high severity” outcomes. This is understandable in that accidents and serious incidents are high profile events and are easy to count. However, from

a safety performance management perspective, there are drawbacks in an overreliance on accidents and serious incidents as a reliable indicator of safety performance. For instance, accidents and serious incidents are infrequent (there may be only one accident in a year, or none) making it difficult to perform statistical analysis to identify trends. This does not necessarily indicate that the system is safe. A consequence of a reliance on this sort of data is a potential false sense of confidence that an organisation's or system's safety performance is effective, when it may in fact be perilously close to an accident.

10.1.9 Leading indicators are measures that focus on processes and inputs that are being implemented to improve or maintain safety. These are also known as "activity or process SPIs" as they monitor and measure conditions that have the potential to become or to contribute to a specific outcome.

10.1.10 Examples of leading SPIs driving the development of organisational capabilities for proactive safety performance management include such things as "percentage of staff who have successfully completed safety training on time" or "frequency of bird scaring activities".

10.1.11 Leading SPIs may also inform the organisation about how their operation copes with change, including changes in its operating environment. The focus will be either on anticipating weaknesses and vulnerabilities as a result of the change, or monitoring the performance after a change. An example of an SPI to monitor a change in operations would be "percentage of sites that have implemented procedure X".

10.1.12 For a more accurate and useful indication of safety performance, lagging SPIs, measuring both "low probability/high severity" events and "high probability/low severity" events should be combined with leading SPIs. Figure 10-1 illustrates the concept of leading and lagging indicators that provide a more comprehensive and realistic picture of the organisation's safety performance.

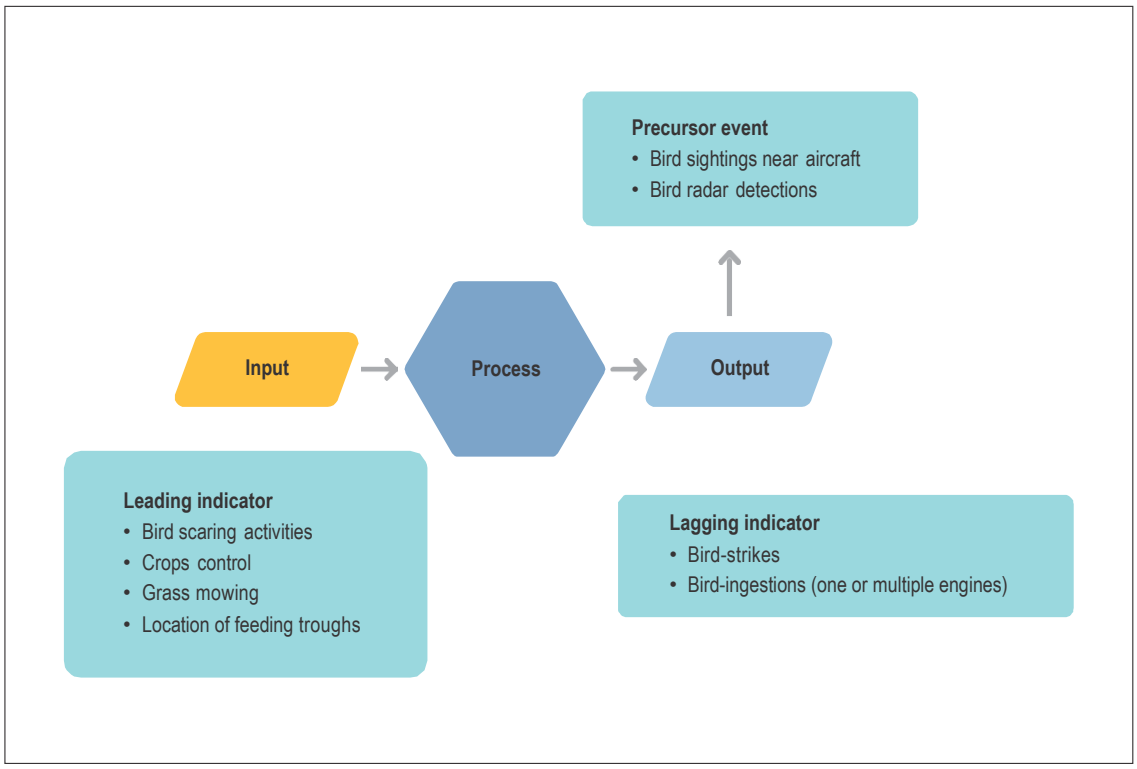


Figure 10-1: Leading vs Lagging indicator concept phases

10.2 Selecting and defining SPIs

10.2.1 SPIs are the parameters that provide the organisation with a view of its safety performance: where it has been; where it is now; and where it is headed, in relation to safety. This picture acts as a solid and defensible foundation upon which the organisation's data-driven safety decisions are made. These decisions, in turn, positively affect the organisation's safety performance. The identification of SPIs should therefore be realistic, relevant, and linked to safety objectives, regardless of their simplicity or complexity.

10.2.2 It is likely the initial selection of SPIs will be limited to the monitoring and measurement of parameters representing events or processes that are easy and/or convenient to capture (safety data that may be readily available). Ideally, SPIs should focus on parameters that are important indicators of safety performance, rather than on those that are easy to attain.

10.2.3 Lagging SPIs are divided into two types:

a) related to the safety objective they aim to indicate;

b) selected or developed based on available data and reliable measurement;

c) appropriately specific and quantifiable; and

d) realistic, by taking into account the possibilities and constraints of the organisation.

10.2.4 A combination of SPIs is usually required to provide a clear indication of safety performance. There should be a clear link between lagging and leading SPIs. Ideally lagging SPIs should be defined before determining leading SPIs. Defining a precursor SPI linked to a more serious event or condition (the lagging SPI) ensures there is a clear correlation between the two. All of the SPIs, lagging and leading, are equally valid and valuable. An example of these linkages is illustrated in Figure 10-2.

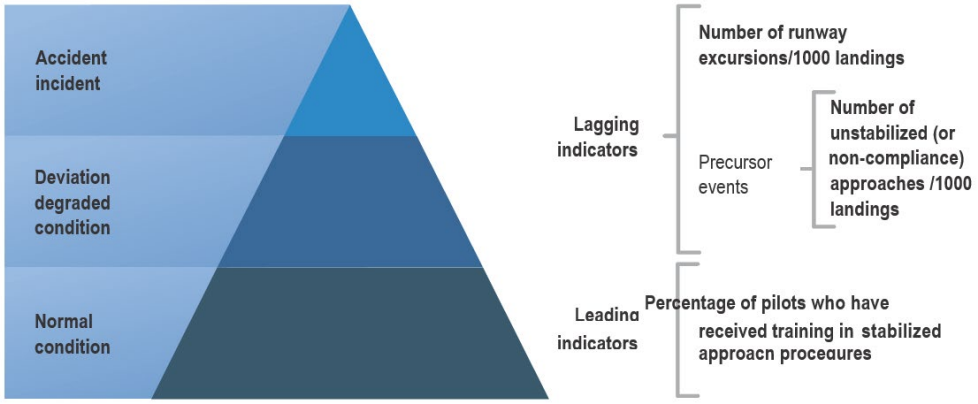


Figure 10-2: Examples of links between lagging and leading indicators

10.2.5 It is important to select SPIs that relate to the organisation's safety objectives. Having SPIs that are well defined and aligned will make it easier to identify SPTs, which will show the progress being made towards the attainment of safety objectives. This allows the organisation to assign resources for greatest safety effect by knowing precisely what is required, and when and how to act to achieve the planned safety performance.

Defining SPIs

10.2.6 The contents of each SPI should include:

a) a description of what the SPI measures;

b) the purpose of the SPI (what it is intended to manage and who it is intended to inform)

c) the units of measurement and any requirements for its calculation;

d) who is responsible for collecting, validating, monitoring, reporting and acting on the SPI (these may be staff from different parts of the organisation);

e) where or how the data should be collected; and

f) the frequency of reporting, collecting, monitoring and analysis of the SPI data.

SPIs and safety reporting

10.2.7 Changes in operational practices may lead to underreporting until their impact is fully accepted by potential reporters. This is known as “reporting bias”. Changes in the provisions related to the protection of safety information and related sources could also lead to over-reporting. In both cases, reporting bias may distort the intent and accuracy of the data used for the SPI. Employed judiciously, safety reporting may still provide valuable data for the management of safety performance.

10.3 Setting safety performance targets

10.3.1 Safety performance targets (SPTs) define short-term and medium-term safety performance management desired achievements. They act as “milestones” that provide confidence that the organisation is on track to achieving its safety objectives and provide a measurable way of verifying the effectiveness of safety performance management activities. SPT setting should take into consideration factors such as the prevailing level of safety risk, safety risk tolerability, as well as expectations regarding the safety of the particular aviation sector. The setting of SPTs should be determined after considering what is realistically achievable for the associated aviation sector and recent performance of the particular SPI, where historical trend data is available.

10.3.2 If the combination of safety objectives, SPIs and SPTs working together are SMART, it allows the organisation to more effectively demonstrate its safety performance. There are multiple approaches to achieving the goals of safety performance management, especially, setting SPTs. One approach involves establishing general high- level safety objectives with aligned SPIs and then identifying reasonable levels of improvements after a baseline safety performance has been established. These levels of improvements may be based on specific targets (e.g. percentage decrease) or the achievement of a positive trend. Another approach which can be used when the safety objectives are SMART is to have the safety targets act as milestones to achieving the safety objectives. Either of these approaches are valid and there may be others that an organisation finds effective at demonstrating their safety performance. Different approaches can be used in combination as appropriate to the specific circumstances.

Setting targets with high-level safety objectives

10.3.3 Targets are established with senior management agreeing on high-level safety objectives. The organisation then identifies appropriate SPIs that will show improvement of safety performance towards the agreed safety objective(s). The SPIs will be measured using existing data sources, but may also require the collection of additional data. The organisation then starts gathering, analysing and presenting the SPIs. Trends will start to emerge, which will provide an overview of the organisation’s safety performance and whether it is steering towards or away from its safety objectives. At this point the organisation can identify reasonable and achievable SPTs for each SPI.

Setting targets with SMART safety objectives

10.3.4 Safety objectives can be difficult to communicate and may seem challenging to achieve; by breaking them down into smaller concrete safety targets, the process of delivering them is easier to manage. In this way, targets form a crucial link between strategy and day-to-day operations. Organisations should identify the key areas that drive the safety performance and establish a way to measure them. Once an organisation has an idea what their current level of performance is by establishing the baseline safety performance, they can start setting SPTs to give everyone in the organisation a clear sense of what they should be aiming to achieve. The organisation may also use benchmarking to support setting performance targets. This involves using performance information from similar organisations that have already been measuring their performance to get a sense of how others in the community are doing.

10.3.5 An example of the relationship between safety objectives, SPIs and SPTs is illustrated in Figure 10-3. In this example, the organisation recorded 100 runway excursions per million movements in 2018. It has been determined this is too many, and an objective to reduce the number of runway excursions by fifty per cent by 2022 has been set. Specific targeted actions and associated timelines have been defined to meet these targets. To monitor, measure and report their progress, the organisation has chosen “RWY excursions per million movements per year” as the SPI. The organisation is aware that progress will be more immediate and effective if specific targets are set which align with the safety objective. They have therefore set a safety target which equates to an average reduction of 12.5 per year over the reporting period (four years). As shown in the graphical representation, the progress is expected to be greater in the first years and less so in the later years. This is represented by the curved projection towards their objective. In the Figure 10-3:

a) the SMART safety objective is “50 per cent reduction in RWY excursions rate by 2022”;

b) the SPI selected is the “number runway excursions per million movements per year”; and

c) the safety targets related to this objective represent milestones for reaching the SMART safety objective and equate to a ~12 per cent reduction each year until 2022;

   1) SPT 1a is “less than 78 runway excursions per million movement in 2019”;
   2) SPT 1b is “less than 64 runway excursions per million movement in 2020”;
   3) SPT 1c is “less than 55 runway excursions per million movement in 2021”.

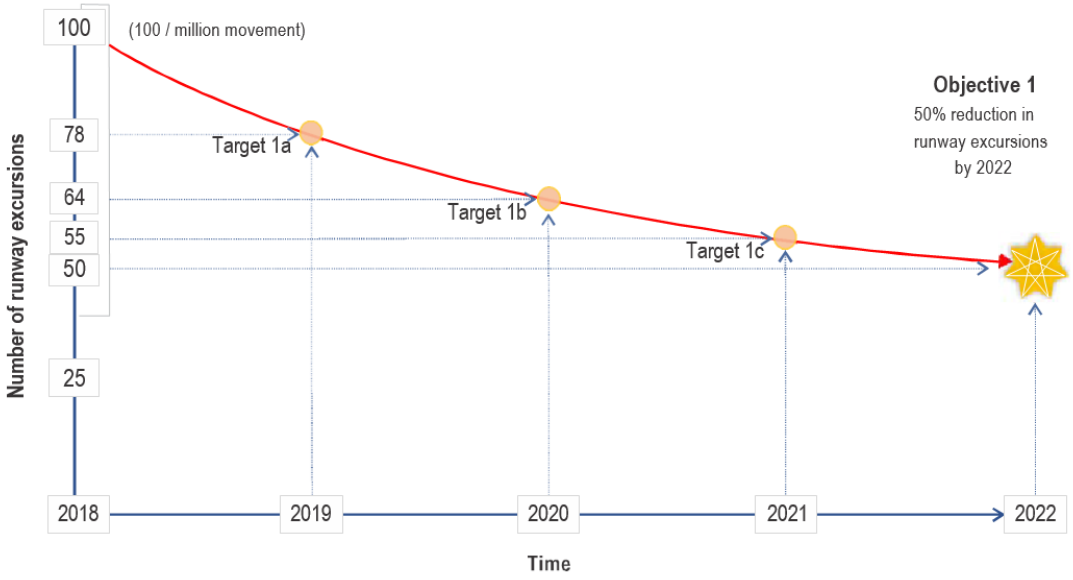


Figure 10-3: Example SPTs with SMART safety objective

Additional considerations for SPI and SPT selection

10.3.6 When selecting SPIs and SPTs, the following should also be considered:

a) *Workload management*. Creating a workable amount of SPIs can help personnel manage their monitoring and reporting workload. The same is true of the SPIs complexity, or the availability of the necessary data. It is better to agree on what is feasible, and then prioritize the selection of SPIs on this basis. If an SPI is no longer informing safety performance, or been given a lower priority, consider discontinuing in favour of a more useful or higher priority indicator.

b) *Optimal spread of SPIs*. A combination of SPIs that encompass the focus areas will help gain an insight to the organisation's overall safety performance and enable data-driven decision-making.

c) *Clarity of SPIs*. When selecting an SPI, it should be clear what is being measured and how often. SPIs with clear definitions aid understanding of results, avoid misinterpretation, and allow meaningful comparisons over time.

d) *Encouraging desired behaviour*. SPTs can change behaviours and contribute to desired outcomes. This is especially relevant if achievement of the target is linked to organisational rewards, such as management remuneration. SPTs should foster positive organisational and individual behaviours that deliberately result in defensible decisions and safety performance improvement. It is equally important to consider the potential unintended behaviours when selecting SPIs and SPTs.

e) *Choosing valuable measures*. It is imperative that useful SPIs are selected, not only ones which are easy to measure. It should be up to the organisation

to decide what the most useful safety parameters are; those that guide the organisation to improve decision-making, safety performance management, and achievement of its safety objectives.

f) *Achieving SPTs*. This is a particularly important consideration, and linked to the desired safety behaviours. Achieving the agreed SPTs is not always indicative of safety performance improvement. The organisation should distinguish between just meeting SPTs and actual, demonstrable organisational safety performance improvement. It is imperative that the organisation consider the context within which the target was achieved, rather than looking at an SPT in isolation. Recognition for overall improvement in safety performance, rather than an individual SPT achievement, will foster desirable organisational behaviours and encourage exchange of safety information that lies at the heart of both SRM and safety assurance. This could also enhance the relationship between the CAAM and the service provider and willingness to share safety data and ideas.

10.4 Safety Performance Measurement

Getting safety performance measurement right involves deciding how best to measure the achievement of the safety objectives. This may vary from service provider to service provider. Organisations should take the time to develop their strategic awareness of what it is that drives safety improvement for their safety objectives.

10.5 Use of SPIs and SPTs

SPIs and SPTs can be used in different ways to demonstrate safety performance. It is crucial that organisations tailor, select and apply various measurement tools and approaches depending on their specific circumstances and the nature of what is being measured. For instance, in some cases, organisations could adopt SPIs that all have specific associated SPTs. In another situation, it may be preferable to focus on achieving a positive trend in the SPIs, without specific target values. The package of selected performance metrics will usually employ a combination of these approaches.

10.6 Monitoring Safety Performance

10.6.1 Once an organisation has identified the targets based on the SPIs they believe will deliver the planned outcome, they must ensure the stakeholders follow through by assigning clear responsibility for delivery.

10.6.2 Mechanisms for monitoring and measuring the organisation’s safety performance should be established to identify what changes may be needed if the progress made isn't as expected and reinforce the commitment of the organisation to meet its safety objectives.

10.6.3 Baseline safety performance

Understanding how the organisation plans to progress towards its safety objectives requires that they know where they are, in relation to safety. Once the organisation's safety performance structure (safety objectives, indicators, targets, triggers) has been established and is functioning, it is possible to learn their baseline safety performance through a period of monitoring. Baseline safety performance is the safety performance at the commencement of the safety performance measurement process, the datum point from which progress can be measured. In the example used in figures 10-2 and 10-3, the baseline safety performance for that particular safety objective was "100 runway excursions per million movements during the year (2018)". From this solid basis, accurate and meaningful indications and targets can be recorded.

10.6.4 Refinement of SPIs and SPTs

10.6.4.1 SPIs and associated SPTs will have to be reviewed to determine if they are providing the information needed to track the progress being made toward the safety objectives and to ensure that the targets are realistic and achievable.

10.6.4.2 Safety performance management is an ongoing activity. Safety risks and/or availability of data change over time. Initial SPIs may be developed using limited resources of safety information. Later, more reporting channels may be established, more safety data may be available and the organisation's safety analysis capabilities will likely mature. It may be appropriate for organisations to develop simple (broader) SPIs initially. As they gather more data and safety management capability, they can consider refining the scope of SPIs and SPTs to better align with the desired safety objectives. Small non-complex organisations may elect to refine their SPIs and SPTs and/or select generic (but specific) indicators which apply to most aviation systems. Some examples of generic indicators would be:

a) events including structural damage to equipment;

b) events indicating circumstances in which an accident nearly occurred;

c) events in which operational personnel or members of the aviation community were fatally or seriously injured;

d) events in which operational personnel became incapacitated or unable to perform their duties safely;

e) rate of voluntary occurrence reports; and

f) rate of mandatory occurrence reports.

10.6.4.3 Larger more complex organisations may elect to institute a broader and/or deeper range of SPIs and SPTs and to integrate generic indicators such as those listed above with activity-specific ones. A large airport, for example, providing services to major airlines and situated under complex airspace, might

consider combining some of the generic SPIs with deeper-scope SPIs representing specific aspects of their operation. The monitoring of these may require greater effort but will likely produce superior safety results. There is a clear correlation between the relative complexity of SPIs and SPTs and the scale and complexity of the service providers' operations. This relative complexity should be reflected in the indicator and target set. Those responsible for establishing safety performance management should be conscious of this.

10.6.4.4 The set of SPIs and SPTs selected by an organisation should be periodically reviewed to ensure their continued meaningfulness as indications of organisational safety performance. Some reasons to continue, discontinue or change SPIs and SPTs include:

a) SPIs continually report the same value (such as zero per cent or 100 per cent); these SPIs are unlikely to provide meaningful input to senior management decision-making;

b) SPIs that have similar behaviour and as such are considered a duplication;

c) the SPT for an SPI implemented to measure the introduction of a programme or targeted improvement has been met;

d) another safety concern becomes a higher priority to monitor and measure;

e) to gain a better understanding of a particular safety concern by narrowing the specifics of an SPI (i.e. reduce the "noise" to clarify the "signal"); and

f) safety objectives have changed and as a consequence the SPIs require updating to remain relevant.

10.6.5 Safety triggers

10.6.5.1 A brief perspective on the notions of triggers is relevant to assist in their eventual role within the context of the management of safety performance by an organisation.

10.6.5.2 A trigger is an established level or criteria value that serves to trigger (start) an evaluation, decision, adjustment or remedial action related to the particular indicator. One method for setting out-of-limits trigger criteria for SPTs is the use of the population standard deviation (STDEVP) principle. This method derives the standard deviation (SD) value based on the preceding historical data points of a given safety indicator. The SD value plus the average (mean) value of the historical data set forms the basic trigger value for the next monitoring period. The SD principle (a basic statistical function) sets the trigger level criteria based on actual historical performance of the given indicator (data set), including its volatility (data point fluctuations). A more volatile historical data set will usually result in a higher (more generous) trigger level value for the next monitoring period. Triggers provide early warnings which enable decision makers to make

informed safety decisions, and thus improve safety performance. An example of trigger levels based on standard deviations (SDs) is provided at Figure 10-4 below. In this example, data-driven decisions and safety mitigation actions may need to be taken when the trend goes beyond +1SD or +2SD from the mean of the preceding period. Often the trigger levels (in this case +1SD, +2SD or beyond +2SD) will align with decision management levels and urgency of action.

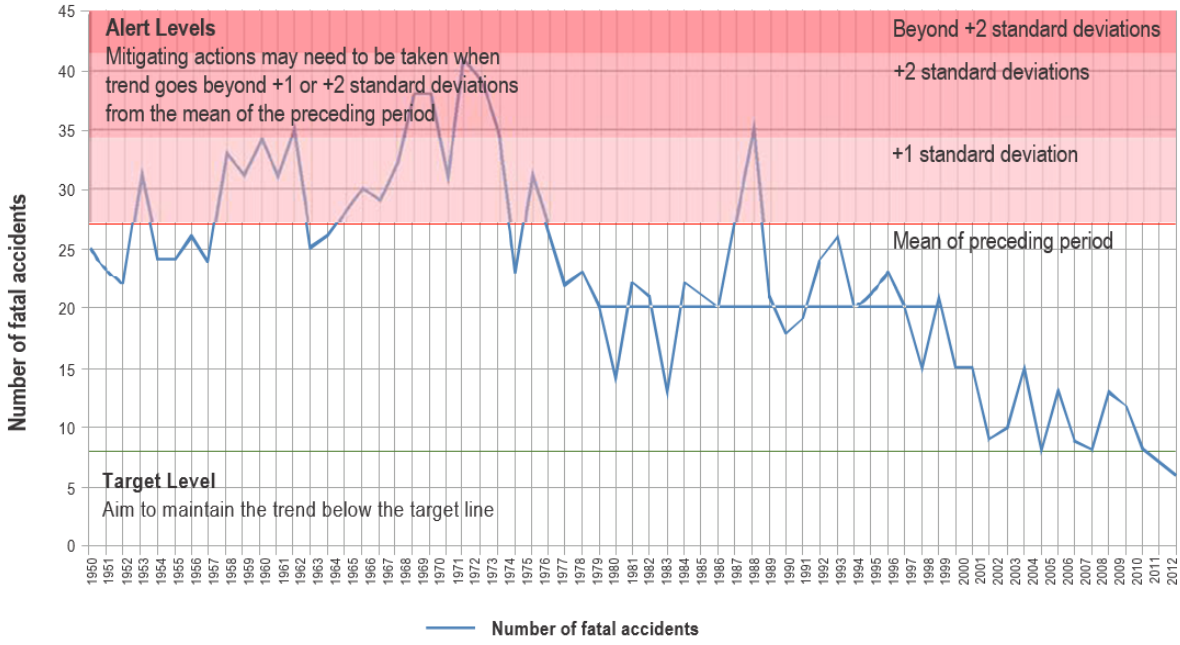


Figure 10-4: Example of representation of safety triggers (alert) levels

10.6.6 Identifying actions required

10.6.6.1 Arguably the most important outcome of establishing a safety performance management structure is the presentation of information to the organisation's decision makers so they can make decisions based on current, reliable safety data and safety information. The aim should always be to make decisions in accordance with the safety policy and towards the safety objectives.

10.6.6.2 In relation to safety performance management, data-driven decision-making is about making effective, well-informed decisions based on the results of monitored and measured SPIs, or other reports and analysis of safety data and safety information. Using valid and relevant safety data combined with information that provides context supports the organisation in making decisions that align with its safety objectives and targets. Contextual information may also include other stakeholder priorities, known deficiencies in the data, and other complementary data to evaluate the pros, cons, opportunities, limitations and risks associated with the decision. Having the information readily available and

easy to interpret helps to mitigate bias, influence and human error in the decision-making process.

10.6.6.3 Data-driven decision-making also supports the evaluation of decisions made in the past to support any realignment with the safety objectives.

10.7 Update of safety objective

10.7.1 Safety performance management is not intended to be "set and forget". Safety performance management is dynamic and central to the functioning of every service providers, and should be reviewed and updated:

a) routinely, in accordance with the periodic cycle established and agreed upon by the high-level safety committee;

b) based on inputs from safety analyses (refer to Chapter 6 for details); and

c) in response to major changes in the operation, top risks or environment.

10.8 Methodology of Safety Performance Monitoring

10.8.1 Tables 10-1 to 10-4 (safety indicator examples) provide illustrative examples of service providers aggregate safety performance indicators (SPIs) and their corresponding alert and target level setting criteria.

Such a summary table may be compiled by the service providers and populated accordingly with as many existing or viable safety indicators as possible. SMS SPIs will need to be developed by service providers in relation to the expectations of the Malaysian Safety Programme's (MSP) safety indicators. In order to ensure congruence between MSP and SMS indicators, the service provider will need to actively engage with CAAM during its development of SMS SPIs. It can be expected for SMS SPIs to be more comprehensive than MSP safety indicators. It is possible that certain safety/ quality indicators may have been maintained by service providers for supplementary purposes and hence need not be included for SMS level monitoring and measurement purposes. These would usually be lower level or other process-specific indicators within the organisation.

10.8.2 Table 10-5 (example of an SMS safety indicator chart) is an example of what a high-consequence SMS safety performance indicator chart looks like. In this case it is the service provider's aggregate reportable/ mandatory incident rates. The chart on the left is the preceding year's performance, while the chart on the right is the current year's progressive data trending. The alert level setting is based on basic safety metrics standard deviation criteria. The Excel spreadsheet formula is "=STDEVP". For the purpose of manual standard deviation calculation, the formula is:

$$\sigma = \sqrt{\frac{\Sigma\,(x-\mu)^2}{N}}$$

where “X” is the value of each data point, “N” is the number of data points and “μ” is the average value of all the data points.

10.8.3 The target setting is a desired percentage improvement (in this case 5%) over the previous year’s data point average. It should be noted that the actual data point interval and occurrence rate denominator will need to be determined based on the nature of each data set, in order to ensure the viability of the safety indicator. For very low frequency occurrences, the data point interval may, for example, have to be on a yearly instead of quarterly update basis.

Likewise, the occurrence rate denominator may, for example, be per 100 000 air movements instead of 1 000 air movements. This chart is generated by the data sheet shown in Table 10-6.

10.8.4 The data sheet in Table 10-6 (data sheet for a sample safety indicator chart) is used to generate the safety indicator chart shown in Table 10-5. The same can be used to generate any other safety indicator chart with the appropriate data entry and safety indicator descriptor customization. The three alert lines and target line are automatically generated based on their respective settings in this data sheet.

10.8.5 Table 10-7 (example of an ALoSP performance summary) is a summary of all the service provider’s safety indicators, with their respective alert and target level outcomes annotated. Such a summary may be compiled at the end of each monitoring period to provide an overview of the service provider’s ALoSP performance. If a more quantitative performance summary measurement is desired, appropriate points may be assigned to each Yes/No response for each target and alert outcome. For example:

High-severity indicators:

Alert level not breached [Yes (4), No (0)]

Target achieved [Yes (3), No (0)]

Low-severity indicators:

Alert level not breached [Yes (2), No (0)]

Target achieved [Yes (1), No (0)]

This may allow a summary score (or percentage) to be obtained to indicate the overall performance of the ALoSP safety indicators at the end of any given monitoring period as shown in Table 10-8.

SMS safety performance indicators					
High-severity indicators			*Low-severity indicators*		
Safety performance indicator	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*
Air operator individual fleet monthly serious incident rate (e.g. per 1,000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator combined fleet monthly incident rate (e.g. per 1,000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate
Air operator combined fleet monthly serious incident rate (e.g. per 1,000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	Consideration	Consideration
Air operator engine IFSD incident rate (e.g. per 1,000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator voluntary hazard report rate (e.g. per 1,000 FH)	Consideration	Consideration
			Operator DGR incident report rate(e.g. per 1,000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate

Table 10-1. Example of safety performance indicators for air operators

SMS safety performance indicators					
High-severity indicators			*Low-severity indicators*		
Safety performance indicator	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*
Aerodrome operator quarterly ground accident/serious incident rate — involving any aircraft (e.g. per 10,000 ground movements)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Aerodrome operator internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	Consideration	Consideration
Aerodrome operator quarterly runway excursion incident rate — involving any aircraft (e.g. per 10,000 departures)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Aerodrome operator quarterly runway foreign object/debris hazard report rate (e.g. per 10,000 ground movements)	Consideration	Consideration
Aerodrome operator quarterly runway incursion incident rate — involving any aircraft (e.g. per 10,000 departures)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator voluntary hazard report rate (per operational personnel per quarter)	Consideration	Consideration
			Aerodrome operator quarterly aircraft ground foreign object damage incident report rate — involving damage to aircraft (e.g. per 10,000 ground movements)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate

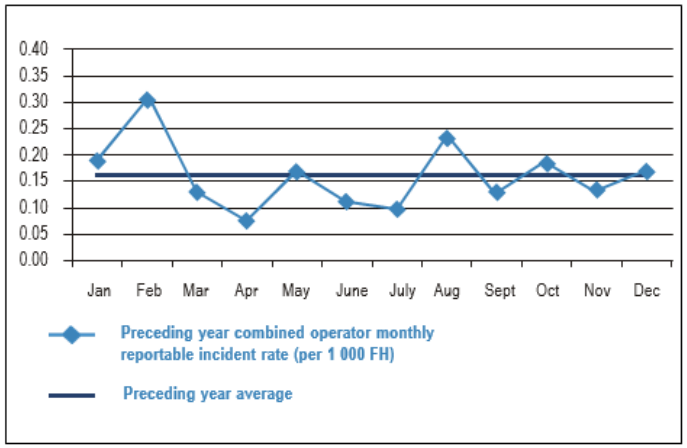
Table 10-2. Example of safety performance indicators for aerodrome operators

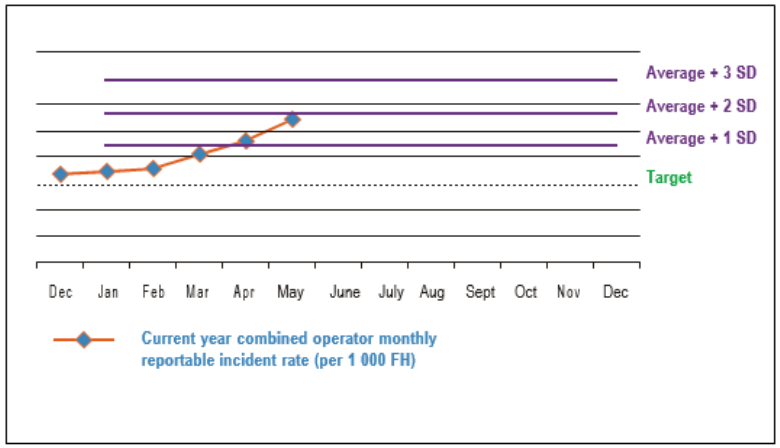
SMS safety performance indicators					
High-severity indicators			*Low-severity indicators*		
Safety performance indicator	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*
ATS operator quarterly FIR serious incident rate — involving any aircraft (e.g. per 100,000 flight movements)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	ATS operator quarterly FIR TCAS RA incident rate — involving any aircraft (e.g. per 100,000 flight movements)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate
ATS operator quarterly/annual near-miss incident rate (e.g. per 100 000 flight movements)	Assuming the historical annual average rate is 3, the possible alert rate could be 5	Assuming the historical annual average rate is 3, the possible target rate could be 2	ATS operator quarterly FIR level bust (LOS) incident rate — involving any aircraft (e.g. per 100,000 flight movements)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate
			ATS operator internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	Consideration	Consideration

Table 10-3. Example of safety performance indicators for ATS operators

SMS safety performance indicators					
High-severity indicators			*Low-severity indicators*		
Safety performance indicator	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*
AMO/PO quarterly rate of component technical warranty claims	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	AMO/PO/DO internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	Consideration	Consideration
PO/DO quarterly rate of operational products which are the subject of ADs/ASBs (per product line)	Consideration	Consideration	AMO/PO/DO quarterly final inspection/testing failure/rejection rate (due to internal quality issues)	Consideration	Consideration
AMO/PO quarterly rate of component mandatory/major defect reports raised (due to internal quality issues)	Consideration	Consideration	AMO/PO/DO voluntary hazard report rate (per operational personnel per quarter)	Consideration	Consideration

Table 10-4. Example of safety performance indicators for Approved Maintenance Organisations (AMO), Design Organisation (DO) and Production Organisation (PO)





a) Alert level setting:

The alert level for a new monitoring period (current year) is based on the preceding period's performance (preceding year), namely its data points average and standard deviation. The three alert lines are average + 1 SD, average + 2 SD and average + 3 SD.

b) Alert level trigger:

An alert (abnormal/unacceptable trend) is indicated if any of the conditions below are met for the current monitoring period (current year):

— any single point is above the 3 SD line
— 2 consecutive points are above the 2 SD line
— 3 consecutive points are above the 1 SD line.

When an alert is triggered (potential high risk or out-of-control situation), appropriate follow-up action is expected, such as further analysis to determine the source and root cause of the abnormal incident rate and any necessary action to address the unacceptable trend.

c) Target level setting (planned improvement):

The target level setting may be less structured than the alert level setting, e.g. target the new (current year) monitoring period's average rate to be say 5% lower (better) than the preceding period's average value.

d) Target achievement:

At the end of the current year, if the average rate for the current year is at least 5% or more lower than the preceding year's average rate, then the set target of 5% improvement is deemed to have been achieved.

e) Alert and target levels — validity period:

Alert and target levels should be reviewed/reset for each new monitoring period, based on the equivalent preceding period's average rate and SD, as applicable.

Table 10-5. Example of a safety performance indicator chart (with alert and target level settings)

Preceding year				
Month	*All operator total FH*	*All operator incidents*	*Incident rate**	*Average*
January	51 837	10.00	0.19	0.16
February	48 406	15.00	0.31	0.16
March	53 354	7.00	0.13	0.16
April	52 513	4.00	0.08	0.16
May	54 037	9.00	0.17	0.16
June	52 673	6.00	0.11	0.16
July	54 086	5.00	0.09	0.16
August	54 043	13.00	0.24	0.16
September	52 383	7.00	0.13	0.16
October	53 042	10.00	0.19	0.16
November	51 353	7.00	0.14	0.16
December	53 006	9.00	0.17	0.16
		Average	0.16	
		SD	0.06	

Current year							
Month	*All operator total FH*	*All operator incidents*	*Incident rate**	*Preceding year average + 1 SD*	*Preceding year average + 2 SD*	*Preceding year average + 3 SD*	*Current year target average*
December	53 006	9.00	0.17				
January	51 635	9.00	0.17	0.23	0.29	0.35	0.15
February	44 295	8.00	0.18	0.23	0.29	0.35	0.15
March	48 323	10.00	0.21	0.23	0.29	0.35	0.15
April	47 176	11.00	0.23	0.23	0.29	0.35	0.15
May	47 469	13.00	0.27	0.23	0.29	0.35	0.15
June				0.23	0.29	0.35	0.15
July				0.23	0.29	0.35	0.15
August				0.23	0.29	0.35	0.15
September				0.23	0.29	0.35	0.15
October				0.23	0.29	0.35	0.15
November				0.23	0.29	0.35	0.15
December				0.23	0.29	0.35	0.15
		Average					
		SD					

Average + 1 SD	Average + 2 SD	Average + 3 SD
0.23	0.29	0.35

Current year target is say 5% average rate improvement over the average rate for the preceding year, which is:	0.15

Current year alert level setting criteria is based on preceding year (Average + 1/2/3 SD).

* Rate calculation (per 1 000 FH).

Table 10-6. Sample data sheet used to generate a high severity safety indicator chart (with alert and target setting criteria)

High-severity indicators					
	SPI description	*SPI alert level criteria (for 2020)*	*Alert level breached (Yes/No)*	*SPI target level criteria (for 2020)*	*Target achieved (Yes/No)*
1	Air operator's fleet monthly serious incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	5% improvement of the 2020 average rate over the 2019 average rate	No
2	Air operator's fleet engine IFSD incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	3% improvement of the 2020 average rate over the 2019 average rate	Yes
3	etc.				

Low-severity indicators					
	SPI description	*SPI alert level criteria (for 2020)*	*Alert level breached (Yes/No)*	*SPI target level criteria (for 2020)*	*Target achieved (Yes/No)*
1	Operator combined fleet monthly incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	5% improvement of the 2020 average rate over the 2019 average rate	No
2	Operator internal QMS annual audit LEI % or findings rate (findings per audit)	More than 25% average LEI or any Level 1 finding or more than 5 Level 2 findings per audit	Yes	5% improvement of the 2020 average rate over the 2019 average rate	Yes
3	Operator voluntary hazard report rate (e.g. per 1 000 FH)	TBD		TBD	
4	Operator DGR incident report rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	No	5% improvement of the 2020 average rate over the 2019 average rate	Yes
5	etc.				

Table 10-7. Example of air operator's ALoSP summary (say for the year 2020)

Note 1.— Other process indicators. Apart from the above SMS level safety indicators, there may be other system level indicators within each operational area of an organisation. Examples would include process- or system-specific monitoring indicators in engineering, operations, QMS, etc., or indicators associated with performance-based programmes such as fatigue risk management or fuel management. Such process- or system-specific indicators should rightly be administered as part of the system or process concerned. They may be viewed as specific system or process level indicators which supplement the higher-level safety performance indicators. They should be addressed within the respective system or process manuals/SOPs as appropriate. Nevertheless, the criteria for setting alert or target levels forsuch indicators should preferably be aligned with that of the SMS level safety performance indicators where applicable.

Note 2.— Selection of indicators and settings. The combination (or package) of high and low severity safety indicators is to be selected by an organisation according to the scope of the organisation's system. For those indicators where the suggested alert or target level setting criteria is not applicable, the organisation may consider alternate criteria as appropriate. General guidance is to set alerts and targets that take into consideration recent historical or current performance.

High-Severity Safety Indicators				
Safety Indicator (SI) Description	SI Alert Level/ Criteria (for 2020)	Alert Level Not Breached [Yes (4), No (0)]	SI Target Level/ Criteria (for 2020)	Target Achieved [Yes (3), No (0)]
Air operator individual fleet monthly serious incident rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	4	5% improvement of the 2020 average rate over the 2019 average rate	3
Air operator combined fleet monthly serious incident rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	0	5% improvement of the 2020 average rate over the 2019 average rate	0
Air operator engine IFSD incident rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	4	5% improvement of the 2020 average rate over the 2019 average rate	3
	Sub-total	8	Sub-total	6
	Max	12	Max	9

Low-Severity Safety Indicators				
Safety Indicator (SI) Description	SI Alert Level/ Criteria (for 2020)	Alert Level Not Breached [Yes (2), No (0)]	SI Target Level/ Criteria (for 2020)	Target Achieved [Yes (1), No (0)]
Operator combined fleet monthly incident rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	0	5% improvement of the 2020 average rate over the 2019 average rate	0
Operator internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	2020 average rate + 1/2/3 SD (annual reset)	2	5% improvement of the 2020 average rate over the 2019 average rate	1
Operator voluntary hazard report rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	0	5% improvement of the 2020 average rate over the 2019 average rate	0
Operator DGR incident report rate (e.g. per 1,000 FH)	2020 average rate + 1/2/3 SD (annual reset)	2	5% improvement of the 2020 average rate over the 2019 average rate	0
	Sub-total	4	Sub-total	1
	Max	8	Max	4

No Alert %	60	Target Achieved %	53.8
Overall ALoSP (2020)		**57.6 %**	

Table 10-8. Quantitative example of air operator's ALoSP

10.9 Malaysia Safety Performance Indicators

10.9.1 The service providers shall implement but not limited to the identified SPIs in accordance with the Appendix 8 of this CAGM.

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11 Appendices

11.1 Appendix 1 – Application Form for Acceptance of Safety Management System and Nomination of Safety Manager (CAAM/SMS/1902-00)

1 The applicant is to obtain the up-to-date application form (CAAM/SMS/1902-00) in CAAM website www.caam.gov.my

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11.2 Appendix 2 – Guidance on the Development of an SMS Manual

1 General

1.1 This appendix serves to guide organisations in their compilation of a top-level SMS manual (or document) to define their SMS framework and its associated elements. The manual can be a stand-alone SMS manual or be integrated as a consolidated SMS section/chapter within an appropriate approved manual of the organisation (e.g. the organisation's exposition manual or company manual). The actual configuration may depend on regulatory expectation.

1.2 Using the suggested format and content items in this appendix and adapting them as appropriate is one way in which an organisation can develop its own top-level SMS manual. The actual content items will depend on the specific SMS framework and elements of the organisation. The description under each element will be commensurate with the scope and complexity of the organisation's SMS processes.

1.3 The manual will serve to communicate the organisation's SMS framework internally as well as with relevant external organisations.

2 Format of the SMS manual

2.1 The SMS manual may be formatted in the following manner:

a) section heading;

b) objective;

c) criteria;

d) cross-reference documents.

2.2 Below each numbered "section heading" is a description of the "objective" for that section, followed by its "criteria" and "cross-reference documents". The "objective" is what the organisation intends to achieve by doing what is described in that section. The "criteria' defines the scope of what should be considered when writing that section. The "cross-reference documents" links the information to other relevant manuals or SOPs of the organisation which contain details of the element or process as applicable.

3 Contents of the Manual

3.1 The contents of the manual may include the following sections:

1) Document control;
2) SMS regulatory requirements;
3) Scope and integration of the safety management system;
4) Safety policy;
5) Safety objectives;
6) Safety accountabilities and key personnel;
7) Safety reporting and remedial actions;
8) Hazard identification and risk assessment;
9) Safety performance monitoring and measurement;
10) Safety-related investigations and remedial actions;
11) Safety training and communication;
12) Continuous improvement and SMS audit;
13) SMS records management;
14) Management of change; and
15) Emergency/ contingency response plan.

3.2 Below is an example of the type of information that could be included in each section using the format prescribed in 2.2.

1. **Document control**

Objective

Describe how the manual(s) will be kept up to date and how the organisation will ensure that all personnel involved in safety-related duties have the most current version.

Criteria

a) Hard copy or controlled electronic media and distribution list.

b) The correlation between the SMS manual and other existing manuals such as the maintenancecontrol manual (MCM) or the operations manual.

c) The process for periodic review of the manual and its

related forms/documents to ensure their continuing suitability, adequacy and effectiveness.

d) The manual's administration, approval and regulatory acceptance process.

Cross-reference documents

Quality manual, engineering manual, etc.

2. **SMS regulatory requirements**

Objective

Address current SMS regulations and guidance material for necessary reference and awareness by allconcerned.

Criteria

a) Spell out the current SMS regulations/standards. Include the compliance timeframe and advisory material references as applicable.

b) Where appropriate, elaborate on or explain the significance and implications of the regulations to the organisation.

c) Establish a correlation with other safety-related requirements or standards where appropriate.

Cross-reference documents

SMS regulation/requirement references, SMS guidance document references, etc.

3. **Scope and integration of the safety management system**

Objective

Describe the scope and extent of the organisation's aviation-related operations and facilities within which the SMS will apply. The scope of the processes, equipment and operations deemed eligible for the organisation's hazard identification and risk management (HIRM) programme should also be addressed.

Criteria

a) Spell out the nature of the organisation's aviation business and its position or role within the industry as a whole.

b) Identify the major areas, departments, workshops and facilities of the organisation within which the SMS will apply.

c) Identify the major processes, operations and equipment which are deemed eligible for the organisation's HIRM programme, especially those which are pertinent to aviation safety. If the scope of the HIRM-eligible processes, operations and equipment is too detailed or extensive, it may be controlled under a supplementary document as appropriate.

d) Where the SMS is expected to be operated or administered across a group of interlinked organisations or contractors, define and document such integration and associated accountabilities as applicable.

e) Where there are other related control/management systems within the organisation, such as QMS, OSHE and SeMS, identify their relevant integration (where applicable) within the aviation SMS.

Cross-reference documents

Quality manual, engineering manual, etc.

4. **Safety policy**

Objective

Describe the organisation's intentions, management principles and commitment to improving aviation safety in terms of the product or service provider. A safety policy should be a short description similar to a mission statement.

Criteria

a) The safety policy should be appropriate to the size and complexity of the organisation.

b) The safety policy states the organisation's intentions, management principles and commitment to continuous improvement in aviation safety.

c) The safety policy is approved and signed by the accountable

executive.

d) The safety policy is promoted by the accountable executive and all other managers.

e) The safety policy is reviewed periodically.

f) Personnel at all levels are involved in the establishment and maintenance of the safety management system.

g) The safety policy is communicated to all employees with the intent that they are made aware of their individual safety obligations.

Cross-reference documents

OSHE safety policy, etc.

5. **Safety objectives**

Objective

Describe the safety objectives of the organisation. The safety objectives should be a short statement that describes in broad terms what the organisation hopes to achieve.

Criteria

a) The safety objectives have been established.

b) The safety objectives are expressed as a top-level statement describing the organisation's commitment to achieving safety.

c) There is a formal process to develop a coherent set of safety objectives.

d) The safety objectives are publicized and distributed.

e) Resources have been allocated for achieving the objectives.

f) The safety objectives are linked to safety indicators to facilitate monitoring and measurement where appropriate.

Cross-reference documents

Safety performance indicators document, etc.

6. Roles and responsibilities

Objective

Describe the safety authorities, responsibilities and accountabilities for personnel involved in the SMS.

Criteria

a) The accountable executive is responsible for ensuring that the safety management system is properly implemented and is performing to requirements in all areas of the organisation.

b) An appropriate safety manager (office), safety committee or safety action groups have been appointed as appropriate.

c) Safety authorities, responsibilities and accountabilities of personnel at all levels of the organisation are defined and documented.

d) All personnel understand their authorities, responsibilities and accountabilities with regard to all safety management processes, decisions and actions.

e) An SMS organisational accountabilities diagram is available.

Cross-reference documents

Company exposition manual, SOP manual, administration manual, etc.

7. Safety reporting

Objective

A reporting system should include both reactive (accident/incident reports, etc.) and proactive/ predictive (hazard reports). Describe the respective reporting systems. Factors to consider include: report format, confidentiality, addressees, investigation/evaluation procedures, corrective/ preventive actions and report dissemination.

Criteria

a) The organisation has a procedure that provides for the capture of internal occurrences including accidents, incidents and other occurrences relevant to SMS.

b) A distinction is to be made between mandatory reports (accidents, serious incidents, major defects, etc.), which are required to be notified to CAAM, and other routine occurrence reports, which remain within the organisation.

c) There is also a voluntary and confidential hazard/occurrence reporting system, incorporating appropriate identity/data protection as applicable.

d) The respective reporting processes are simple, accessible and commensurate with the size of the organisation.

e) High-consequence reports and associated recommendations are addressed to and reviewed by the appropriate level of management.

f) Reports are collected in an appropriate database to facilitate the necessary analysis.

Cross-reference documents

- - - - - - - - - - - - - -

8. Hazard identification and risk assessment

Objective

Describe the hazard identification system and how such data are collated. Describe the process for the categorization of hazards/risks and their subsequent prioritization for a documented safety assessment. Describe how the safety assessment process is conducted and how preventive action plans are implemented.

Criteria

a) Identified hazards are evaluated, prioritized and processed for risk assessment as appropriate.

b) There is a structured process for risk assessment involving the evaluation of severity, likelihood, tolerability and preventive controls.

c) Hazard identification and risk assessment procedures focus on aviation safety as their fundamental context.

d) The risk assessment process utilises worksheets, forms or software appropriate to the complexity of the organisation and operations involved.

e) Completed safety assessments are approved by the appropriate level of management.

f) There is a process for evaluating the effectiveness of the corrective, preventive and recovery measures that have been developed.

g) There is a process for periodic review of completed safety assessments and documenting their outcomes.

Cross-reference documents

- - - - - - - - - - - - - -

6. **Safety performance monitoring and measurement**

Objective

Describe the safety performance monitoring and measurement component of the SMS. This includes the organisation's SMS safety performance indicators (SPIs).

Criteria

a) The formal process to develop and maintain a set of safety performance indicators and their associated performance targets.

b) Correlation established between the SPIs and the organisation's safety objectives where applicable and the process of regulatory acceptance of the SPIs where required.

c) The process of monitoring the performance of these SPIs including remedial action procedure whenever unacceptable or abnormal trends are triggered.

d) Any other supplementary SMS or safety performance monitoring and measurement criteria or process.

Cross-reference documents

- - - - - - - - - - - - - -

7. **Safety-related investigations and remedial actions**

Objective

Describe how accidents/incidents/occurrences are investigated and processed within the organisation, including their correlation with the organisation's SMS hazard identification and risk management system.

Criteria

a) Procedures to ensure that reported accidents and incidents are investigated internally.

b) Dissemination of completed investigation reports internally as well as to CAAM as applicable.

c) A process for ensuring that corrective actions taken or recommended are carried out and for evaluating their outcomes/effectiveness.

d) Procedure on disciplinary inquiry and actions associated with investigation report outcomes.

e) Clearly defined conditions under which punitive disciplinary action would be considered (e.g. illegal activity, recklessness, gross negligence or wilful misconduct).

f) A process to ensure that investigations include identification of active failures as well as contributing factors and hazards.

g) Investigation procedure and format provides for findings on contributing factors or hazards to be processed for follow-up action by the organisation's hazard identification and risk management system where appropriate.

Cross-reference documents

- - - - - - - - - - - - - -

8. **Safety training and communication**

Objective

Describe the type of SMS and other safety-related training that staff receive and the process for assuring the effectiveness of the

training. Describe how such training procedures are documented. Describe the safety communication processes/channels within the organisation.

Criteria

a) The training syllabus, eligibility and requirements are documented.

b) There is a validation process that measures the effectiveness of training.

c) The training includes initial, recurrent and update training, where applicable.

d) The organisation's SMS training is part of the organisation's overall training programme.

e) SMS awareness is incorporated into the employment or indoctrination programme.

f) The safety communication processes/channels within the organisation.

Cross-reference documents

- - - - - - - - - - - - - -

9. **Continuous improvement and SMS audit**

Objective

Describe the process for the continuous review and improvement of the SMS.

Criteria

a) The process for regular internal audit/ review of the organisation's SMS to ensure its continuing suitability, adequacy and effectiveness.

b) Describe any other programmes contributing to continuous improvement of the organisation's SMS and safety performance, e.g. MEDA, safety surveys, ISO systems.

Cross-reference documents

- - - - - - - - - - - - - -

10. **SMS records management**

Objective

Describe the method of storing all SMS-related records and documents.

Criteria

a) The organisation has an SMS records or archiving system that ensures the retention of all records generated in conjunction with the implementation and operation of the SMS.

b) Records to be kept include hazard reports, risk assessment reports, safety action group/ safety meeting notes, safety performance indicator charts, SMS audit reports and SMS training records.

c) Records should be traceable for all elements of the SMS and be accessible for routine administration of the SMS as well as internal and external audits purposes.

Cross-reference documents

- - - - - - - - - - - - - -

11. **Management of change**

Objective

Describe the organisation's process for managing changes that may have an impact on safety risks and how such processes are integrated with the SMS.

Criteria

a) Procedures to ensure that substantial organisational or operational changes take into consideration any impact which they may have on existing safety risks.

b) Procedures to ensure that appropriate safety assessment is performed prior to introduction of new equipment or processes which have safety risk implications.

c) Procedures for review of existing safety assessments whenever there are changes to the associated process or equipment.

Cross-reference documents

Company SOP relating to management of change, etc.

12. **Emergency/ contingency response plan**

Objective

Describe the organisation's intentions regarding, and commitment to dealing with, emergency situations and their corresponding recovery controls. Outline the roles and responsibilities of key personnel. The emergency response plan can be a separate document or it can be part of the SMS manual.

Criteria (as applicable to the organisation)

a) The organisation has an emergency plan that outlines the roles and responsibilities in the event of a major incident, crisis or accident.

b) There is a notification process that includes an emergency call list and an internal mobilization process.

c) The organisation has arrangements with other agencies for aid and the provision of emergency services as applicable.

d) The organisation has procedures for emergency mode operations where applicable.

e) There is a procedure for overseeing the welfare of all affected individuals and for notifying next of kin.

f) The organisation has established procedures for handling the media and insurance-related issues.

g) There are defined accident investigation responsibilities within the organisation.

h) The requirement for preservation of evidence, securing the affected area, and mandatory/ governmental reporting is clearly stated.

i) There is emergency preparedness and response training for affected personnel.

j) A disabled aircraft or equipment evacuation plan has been developed by the organisation in consultation with aircraft/equipment owners, aerodrome operators or other agencies as applicable.

k) A procedure exists for recording activities during an emergency response.

Cross-reference documents

ERP manual, etc.

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11.3 Appendix 3 – Job Description for a Safety Manager

1 Overall purpose

The safety manager is responsible to the accountable executive for providing guidance and direction for the planning, implementation and operation of the organisation's safety management system (SMS). The safety manager provides SMS-related services to the certificated, non-certificated and third-party areas of the organisation that are included in the SMS and may have delegated responsibilities on behalf of persons holding positions required by regulations.

2 Key roles

Safety advocate

- Demonstrates an excellent safety behaviour and attitude, follows regulatory practices and rules, recognizes and reports hazards and promotes effective safety reporting.

Leader

- Models and promotes an organisational culture that fosters safety practices through effective leadership.

Communicator

- Acts as an information conduit to bring safety issues to the attention of management and to deliver safety information to the organisation's staff, contractors and stakeholders.

- Provides and articulates information regarding safety issues within the organisation.

Developer

- Assists in the continuous improvement of the hazard identification and safety risk assessment schemes and the organisation's SMS.

Relationship builder

- Builds and maintains an excellent working relationship with the organisation's safety action group (SAG) and within the safety services office (SSO).

Ambassador

- Represents the organisation on government, international organisation and industry committees (e.g. ICAO, IATA, CAAM, AAIB, etc.).

Analyst

- Analyses technical data for trends related to hazards, events and occurrences.

Process management

- Effectively utilises applicable processes and procedures to fulfil roles and responsibilities.
- Investigates opportunities to increase the efficiency of processes.
- Measures the effectiveness and seeks to continually improve the quality of processes.

3 Responsibilities

Among other duties, the safety manager is responsible for:

a) managing the operation of the safety management system;

b) collecting and analysing safety information in a timely manner;

c) administering any safety-related surveys;

d) monitoring and evaluating the results of corrective actions;

e) ensuring that risk assessments are conducted when applicable;

f) monitoring the industry for safety concerns that could affect the organisation;

g) being involved with actual or practice emergency responses;

h) being involved in the development and updating of the emergency response plan and procedures; and

i) ensuring safety-related information, including organisational goals and objectives, are made available to all personnel through established communication processes.

4 Nature and scope

The safety manager must interact with operational personnel, senior managers and departmental heads throughout the organisation. The safety manager should also foster positive relationships with regulatory authorities, agencies and product and service providers outside the organisation. Other contacts will be established at a working level as appropriate.

5 Qualifications

To qualify as a safety manager a person should have:

a) full-time experience in aviation safety in the capacity of an aviation safety investigator, safety/ quality manager or safety risk manager;

b) sound knowledge of the organisation’s operations, procedures and activities;

c) broad aviation technical knowledge;

d) an extensive knowledge of safety management systems (SMS) and have completed appropriate SMS training;

e) an understanding of risk management principles and techniques to support the SMS;

f) experience implementing and/ or managing an SMS;

g) experience and qualifications in aviation accident/incident investigation and human factors;

h) experience and qualifications in conducting safety/quality audits and inspections;

i) sound knowledge of aviation regulatory frameworks, including ICAO Standards and Recommended Practices (SARPS) and relevant civil aviation regulations;

j) the ability to communicate at all levels both inside and outside the company;

k) the ability to be firm in conviction, promote a “just and fair culture” and yet advance an open and non-punitive atmosphere for reporting;

l) the ability and confidence to communicate directly to the accountable executive as his advisor and confidante;

m) well-developed communication skills and demonstrated interpersonal skills of a high order, with the ability to liaise with a variety of individuals and organisational representatives, including those from differing cultural backgrounds; and

n) computer literacy and superior analytical skills.

6 Authority

6.1 Regarding safety matters, the safety manager has direct access to the accountable executive and appropriate senior and middle management.

6.2 The safety manager is authorised under the direction of the accountable executive to conduct safety audits, surveys and inspections of any aspect of the operation in accordance with the procedures specified in the safety management system documentation.

6.3 The safety manager is authorised under the direction of the accountable executive to conduct investigations of internal safety events in accordance with the procedures specified in the organisation’s SMS documentation.

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

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11.4 Appendix 4 – SMS Gap Analysis Checklist and Implementation Plan

1 SMS Gap Analysis Checklist (CAAM/SMS/1902-01)

1.1 The applicant is to obtain the up-to-date SMS Gap Analysis Checklist on CAAM website www.caam.gov.my

1.2 The SMS Gap Analysis Checklist can be used as a template to conduct the first step of an SMS gap analysis. This format with its overall "Yes/No/Partial" responses will provide an initial indication of the broad scope of gaps and hence overall workload to be expected. The questionnaire may be adjusted to suit the needs of the organisation and the nature of the product or service provided. This initial information should be useful to senior management in anticipating the scale of the SMS implementation effort and hence the resources to be provided. This initial checklist would need to be followed up by an appropriate implementation plan as per Tables A4-1 and Table A4-2.

1.3 A "Yes" answer indicates that the organisation meets or exceeds the expectation of the question concerned. A "No" answer indicates a substantial gap in the existing system with respect to the question's expectation. A"Partial" answer indicates that further enhancement or development work is required to an existing process in order to meet the question's expectations.

2 Detailed SMS Gap Analysis and Implementation Tasks (Table A4-1)

2.1 The SMS Gap Analysis Checklist should then be followed up by using the detailed "SMS gap analysis and implementation task identification plan" in Table A4-1. Once completed, Table A4-1 will provide follow-up analysis on details of the gaps and help translate these into actual required tasks and subtasks in the specific context of the organisation's processes and procedures. Each task will then accordingly be assigned to appropriate individuals or groups for action. It is important that correlation of individual element/ task development with their descriptive placeholders in the SMS document be provided for in Table A4-1 in order to trigger progressive updating of the draft SMS document as each element is implemented or enhanced. (Initial element write-ups in SMS documents tend to be anticipatory rather than declaratory.

3 Actions/ Tasks Implementation Schedule (Table A4-2)

Table A4-2 will show the milestones (start-end dates) scheduled for each task/ action. For a phased implementation approach, these tasks/ actions will need to be sorted according to the phase allocation of their related elements. Refer to Chapter 7.8 of this CAGM for the phased prioritization of SMS elements as appropriate. Table A4-2 can be a separate consolidation of all outstanding actions/ tasks or, if preferred, be a continuation of Table A4-1 in the form of a spreadsheet. Where it is anticipated that the actual number of tasks/ actions and their milestones are sufficiently voluminous and complex so as to require utilising a project management software to manage them, this may be done by using software such as MS project/Gantt chart as appropriate. Table A4-3 is an illustration of a Gantt chart.

GAQ Ref.	*Gap analysis question*	*Answer (Yes/No/Partial)*	*Description of gap*	*Action/task required to fill the gap*	*Assigned task group/person*	*SMS document reference*	*Status of action/task (Open/WIP/Closed)*
1.1-1	Is there a safety policy in place?	Partial	The existing safety policy addresses OSHE only.	a) enhance the existing safety policy to include aviation SMS objectives and policies or develop a separate aviation safety policy; b) have the safety policy approved and signed by the accountable executive.	Task Group 1	Chapter 1, Section 1.3.	Open
etc.							

Table A4-1. Example of gap analysis and implementation task identification plan

Action/task required to fill the gap	*SMS document ref.*	*Assigned task group/ person*	*Status of action/ task*	*Schedule/timeline*													
				1Q 10	*2Q 10*	*3Q 10*	*4Q 10*	*1Q 11*	*2Q 11*	*3Q 11*	*4Q 11*	*1Q 12*	*2Q 12*	*3Q 12*	*4Q 12*	*etc.*
1.1-1 a) Enhance the existing safety policy to include aviation SMS objectives and policies or develop a separate aviation safety policy.	Chapter 1, Section 1.3.	Task Group 1	Open														
1.1-1 b) Require the safety policy to be approved and signed by the accountable executive.																	
etc.																	

Table A4-2. Example of SMS implementation schedule

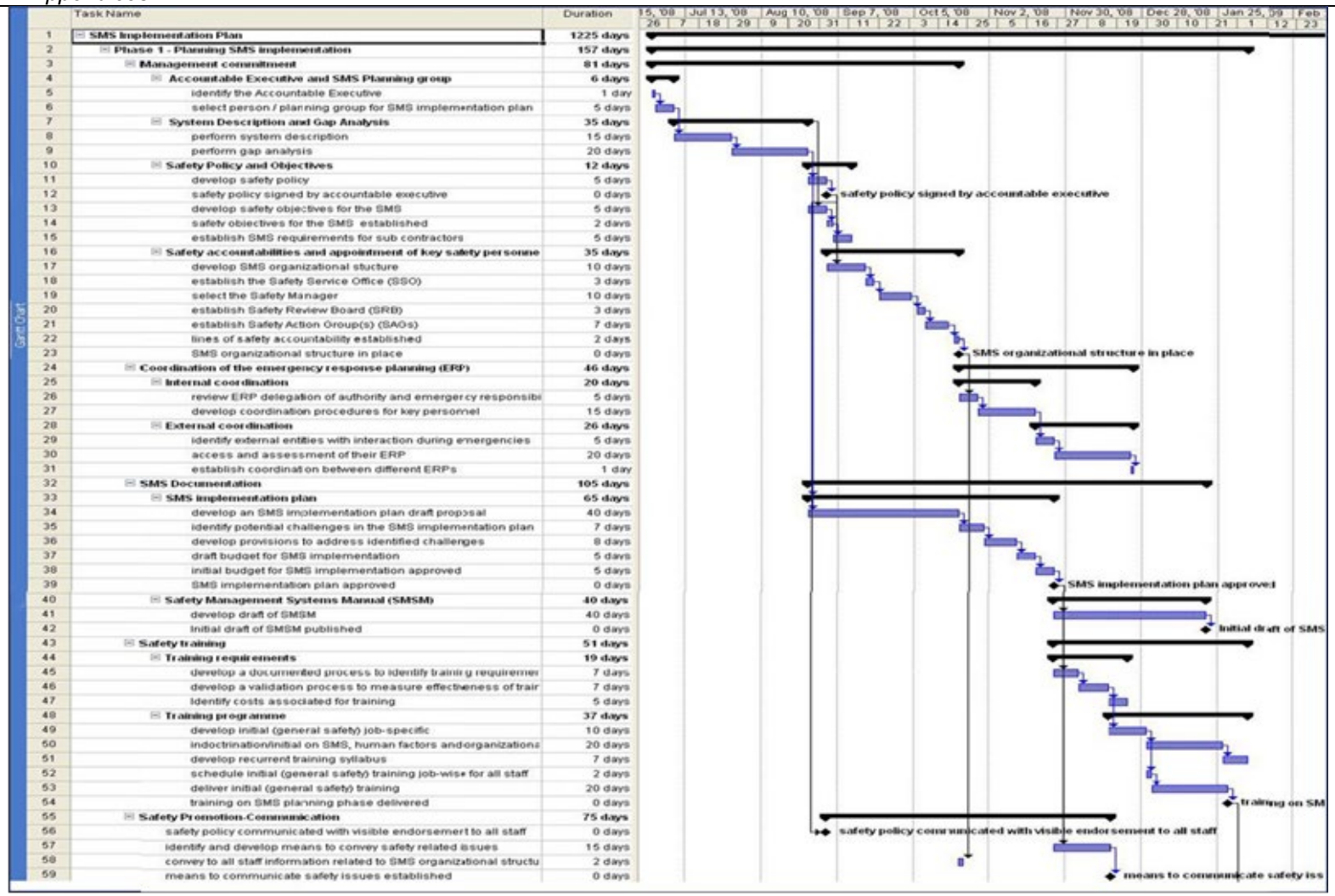

Table A4-3. Example of SMS implementation schedule (Gantt chart)

11.5 Appendix 5 – SMS Initial Acceptance Checklist (CAAM/SMS/1902-02)

The applicant is to obtain the up-to-date SMS Initial Acceptance Checklist on CAAM website www.caam.gov.my

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11.6 Appendix 6 – SMS Maturity Checklist (CAAM/SMS/1902-03)

The applicant is to obtain the up-to-date SMS Initial Acceptance Checklist on CAAM website www.caam.gov.my

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11.7 Appendix 7 – Examples of Hazard Taxonomies

In coordination with the Commercial Aviation Safety Team (CAST)/ICAO Common Taxonomy Team (CICTT), the following high-level hazard taxonomy categories have been established:

a) Organisational – Management or documentation, processes and procedures

b) Environmental – Weather or Wildlife

c) Human – Limitation of the human which in the system has the potential for causing harm

d) Technical – Aerodrome, Air Navigation, Operations, Maintenance, and Design and Manufacturing

Organisational

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome, Air Navigation Service Provider, Air Operation, Maintenance Organisation, Design & Manufacturing Organisation	Regulator	Lack of, poor or ineffective legislation and/ or regulations
		Lack of or ineffective accident investigation capability
		Inadequate oversight capability
	Management	Limited or lack of management commitment – Management do not demonstrate support for the activity
		Lack of or incomplete description of roles, accountabilities andresponsibilities
		Limited or lack of resource availability or planning, including staffing
		Lack of or ineffective policies
		Incorrect or incomplete procedures including instructions
		Lack of or poor management and labour relationships
		Lack of or ineffective organisational structure
		Poor organisational safety culture

Organisational

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome, Air Navigation Service Provider, Air Operation, Maintenance Organisation, Design & Manufacturing Organisation (continued)	Management (continued)	Lack of or ineffective safety management processes (including risk management, safety assurance, auditing, training and resource allocation)
		Lack or ineffective audit procedures
		Lack of or limited resource allocation
		Incorrect or incomplete or lack of training and knowledgetransfer. *Note: Training should reflect the needs of the organisation. Accidents have shown that inadequate training is a hazard and may even lead to accidents.*
		Unofficial organisational structures *Note: These structures may be of a benefit but also may lead to ahazard.*
		Growth, strikes, recession or organisational financial distress
		Mergers or acquisition
		Changes, upgrades or new tools, equipment, processes orfacilities
		Incorrect or ineffective shift/crew member change overprocedures
		Changes or turnover in management or employees
		Informal processes (Standard Operating Procedures)
		Lack of or poor or inappropriate materials/ equipment acquisition decision
		Lack of, poor staffing recruitment/ assignment *Note: Staff should be hired or assigned according to organisational needs but also according to their skills, qualifications and abilities. An employee with the wrong skill set can be a hazard. This includes management.*
		Incorrect, poor or lack of internal and external communicationincluding language barriers
	Documentation, Processes and Procedures	Lack of, incorrect or incomplete manuals, or operatingprocedures (including maintenance)
		Lack of, incorrect or incomplete employee duty descriptions
		Lack of, incorrect, incomplete or complicated document update processes

Organisational

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
	Documentation, Processes and Procedures (continued)	Lack of, incorrect or incomplete reports and records
		Lack of, incorrect or incomplete control of necessary documents for personnel (licences, ratings, and certificates)

Environmental

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome, Air Navigation Service Provider, Air Operation, Maintenance Organisation (Effects may not be all encompassing)	Weather/ Natural Disasters	Thunderstorms and lightning
		Hail
		Heavy rain
		Fog (reduced visibility)
		Wind shear
		Sand storm
		Snow or ice storms
		Excessive or cross winds
		Hurricane, Tsunami, or tornado
		Floods
		Ash (including volcanic or forest fire)
		Earthquake
		Extreme temperatures
		Icing conditions (Impact on aircraft surfaces)
	Geography	Mountains or bodies of water
		Altitude at the aerodrome
	Wildlife	Wildlife on airfield
		Flying wildlife

Human

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome, Air Navigation Service Provider, Air Operation, Maintenance Organisation, Design & Manufacturing Organisation	Sudden Incapacitation	Heart attack, stroke, kidney stone, seizure
	Subtle Incapacitation/ Impairment	Nausea, diarrhoea, Carbon Monoxide, medication, fatigue
	Illness	Influenza, Upper Respiratory Tract Infection (TI), Urinary TI
	Static Limitations	Colour vision, visual field limitations, mobility limitations,colostomy bag, hearing loss
	Self-Imposed Stresses	Fatigue (lack of sleep), alcohol and substance abuse, medications, complacency
	Psycho-Social Stresses	Financial, birth of child, divorce, bereavement, challenging timelines, inadequate resources
	Trauma	In-flight turbulence cabin crew injury, injury caused to personnel during ground aircraft operations or luggage handling
	Environmental/ Occupational	Jet lag, Paint shop, Solvents, Chemical/Biological exposures,Noise, Vibrations, Distractions
	Latent Failures Related to Man/ Machine/ Process Interface	Human factors related to design, manufacturing, maintenanceand operations.
	CognitiveCapacity	Excessive number of aircraft in a controller's area; Varying multi-tasking actions; Over saturation of digital information

Technical - Aerodrome

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome	Runway Operations	Construction, vehicles and people on movement area
		Poor aerodrome design (Intersecting runways; Obstacleclearance; Taxiway crossing runways)
		Distracting lights
		Lack of coordination with Air Traffic Control (ATC)
		Improper, inadequate, or lack of Notices to Airmen(NOTAMs) issuance
		Laser beams

Technical - Aerodrome

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome (continued)	Runway Condition	Poor condition or improper runway surface
		Inadequate runway length
		Lack of, or inadequate runway protected areas
	Airfield Apron Operation	Jet blast
		Lack of, limited or incorrect type of aircraft parking
		Improper marshalling
		Lack of, or insufficient protective pylons around aircraft
		Lack of, or inadequate chalks when aircraft parks
		Lack of, or improper foreign object debris (FOD) control
		Lack of, or improper ramp control tie down procedures
		Improper fuel or hazardous material spill containment and clean up
		Poor refuelling procedures
	Airside Vehicle Operations	Vehicle failure during aerodrome services
		Poor mechanical condition
		Poor radio or communication equipment condition
		Oil spills on apron and/or in passenger areas
		Lack of vehicle maintenance
		Poor Emergency Reponses Planning
		Erratic driving or not complying with flight line drivingregulations
		Driving too fast
		Improper parking
		Failure to chalk vehicles
		Leaving engine running while vehicle is unattended
		Lack of coordination between vehicles during aircraft servicing
	Action of Individuals	Pedestrians on apron areas
		Ignoring aircraft hazard beacons
		Improper checking around aircraft during departure marshalling
		Misinterpreting apron markings
		Smoking on the apron
		Passenger failure to follow guidance
		Use of cell phone within 15 meters of a refuelling operation
		Littering on ramp
		Running on apron

Technical - Aerodrome

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aerodrome (continued)	Facilities	Faulty electrical power supply systems on airport or navigational aids (radars, satellites, very high frequency (VHF) omni-directional radio range (VOR), Automatic Dependent Surveillance - Broadcast (ADS-B), etc.)
		Faulty, incorrect or incomplete airfield markings (especially inmovement areas)
		Faulty, incorrect, or incomplete airfield lighting (especially inmovement areas)
		Faulty, incorrect, or incomplete approach lighting
		Poor condition or inappropriate runway surface
		Poor condition or inappropriate apron surface
		Taxiway and runway system complexity
		Inadequate airfield or terrain drainage
		Insufficient equipment, radios, infrastructure, or personnel
		Issues that attract wildlife (high grass, proximity of landfills,nearby water bodies)
		Inadequate or inappropriate firefighting equipment
		Lack of or limited parking areas
		Lack of safety protective equipment

Technical – Air Navigation Service Provider (ANSP)

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
ANSP	Traffic pattern	Traffic complexity (mixture of aircraft type)
		Excessive aircraft in pattern or given airspace
		Ineffective design and flow of traffic pattern
		Runway incursions by aircraft or vehicles
		Unauthorised flights entering into traffic pattern
		Unauthorised procedures by aircraft
		Similar sounding or confusing call signs
		Lack of or poor procedures for aircraft in distress

Technical – Air Navigation Service Provider (ANSP)

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
ANSP (continued)	Airspace	Insufficient airspace for typical traffic
		Improperly distributed airspace
		Airspace combined during excessive traffic
		Confusing labelling of fixes or way points
		Improperly developed instrument procedures
		Aircraft incorrectly performing missed approach procedures
		Intermingling of ICAO and national instrument procedurecriteria
	Controller actions	Incomplete clearances
		Misidentification of aircraft or targets (radar)
		Improper reading of clearance instructions
		Loss of separation between aircraft
		Loss of separation between aircraft and terrain or obstacles
		Misinterpretation of pilot desires
		Incorrect judgment of aircraft characteristics
	Communications	Incorrect, confusing, or incomplete communication betweenATC and aerodrome personnel
		Incorrect, confusing, or incomplete communication between ATC and aircraft
		Incorrect, confusing, or incomplete coordination between orwithin ATC facilities
		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

Technical – Air Navigation Service Provider (ANSP)

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
ANSP (continued)	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
		Taxiway and runway system complexity
		Inadequate airfield or terrain drainage
		Insufficient equipment, radios, infrastructure, or personnel

Technical - Air Operation and Maintenance

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
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
		Inadequate airfield drainage
		Insufficient equipment, radios, infrastructure, or personnel
		Lack of, limited or incorrect type of aircraft parking
		Poor HVAC (heating, ventilation, and air conditioning)
		Noisy environment
		Lack of or poor Lighting
		Poor facilities (inadequate space)

Technical - Air Operation and Maintenance

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Air Operation (continued)	Pre-flight Preparation	Lack of or 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
		Poor fuelling processes
		Lack of or poor aircraft dispatch or release
		Lack of or poor maintenance release
	Aircraft Loading	Incorrect cargo loading and distribution
		Improper or unauthorised hazardous materials carriage
		Poor cargo and baggage stowage
		Incorrect information on cargo or baggage loaded
		Improper stowage of carry-on baggage
		Improper weight and balance calculations
	Flight Operation	Use of obsolete documents
		Absence of or incorrect flight and cabin crew manuals orcharts on board
		Improper response to flight route changes
		Lack of, or poor crew resource management
		Lack of or poor flight following
		Improper execution of procedures in all flight phases (including taxiing and parking)
		Inadequate or complicated procedures
		Equipment and instruments necessary for a particular flight or operation not available or malfunctioning
		Lack of, or poor communication (ATC, ramp, maintenance,flight Ops, cabin, dispatch, etc)
		Language barriers (Multiple languages)

Technical - Air Operation and Maintenance

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
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 maintenancecompleted outside the maintenance facility or organisation including third party maintenance)
		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

Technical - Air Operation and Maintenance

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Maintenance (continued)	Tooling	Lack of, or poor tool accountability (Including traceability orregistration)
		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
	Maintainability	Complex design (Difficult fault isolation, multiple similar connections, etc)
		Inaccessible component/ area
		Aircraft configuration variability (Similar parts on different models)

Technical – Design and Manufacturing

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aircraft Design	Safety Requirements Capture	Non-compliance with applicable regulations (For example FAA 14 CFR part 23, 25, 27, 29, 33).
		Inadequate Functional Hazard Assessment.
		Inadequate structural static and dynamic loads analysis.
		Inadequate Preliminary System Safety Assessment.
		Inadequate common cause analysis.
	Safety Requirements Validation	Incomplete or ineffective design reviews, analysis, simulator, wind tunnel and flight testing.
		Ineffective or incomplete structural external, internal, andelemental loads analysis.
	Safety Requirement Verification	Incomplete structures load verification, such as static loadtests, ground vibration tests, and flight tests.
		Inadequate System Safety Assessments (SSA) process including lack of, or improper verifying of, failure effects using failure performance testing.
		Inadequate verification of software and complex hardware

Technical – Design and Manufacturing

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aircraft Design (continued)	Aircraft Integration	Inadequate requirements traceability
		Inadequate design requirements control
		Inadequate verification of system/system and system/structure unintended functions and physical interference, such as lack of Bench/Sim/Airplane Testing and inadequate zonal inspections
	Continued Operational Safety	Ineffective in-service monitoring methods such as lack offailure reporting and tracking.
		Inadequate or no root cause analysis, risk analysis, corrective action development, corrective action validation, and incorporation of corrective action and lessons learned into Design Process
	Design Control	Lack of methods for approving, controlling, and documentinginitial designs and design changes
		Inadequate planning and integration of the facility's procedures for continuously maintaining the integrity of design data, drawings, part lists, and specifications necessary to define the configuration and the design features of the product
Aircraft Manufacturing	Manufacturing Processes	Lack of processes for the control of materials, parts, or assemblies, how they are accepted, worked or fabricated,tested, inspected, stored, and prepared for shipment
		Problems with special manufacturing processes and specificfunctions and operations necessary for the fabrication and inspection of parts and assemblies (some examples are machining, riveting, and assembling).
		Ineffective or lack of procedures to ensure materials, parts, orassemblies 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).
		Inadequate methods used to accept and protect raw materials,parts, subassemblies, assemblies, and completed products during receipt, manufacture, inspection, test, storage, and preparation for shipment.

Technical – Design and Manufacturing

Type of operation	Type of activity/ infrastructure/ system	Examples of Hazards
Aircraft Manufacturing (continued)	Manufacturing Processes (continued)	Inadequate Airworthiness Determination, which is the function that provides for evaluation of completed products/parts thereof, and related documentation, to determine conformity to approved design data and theircondition for safe operation.
	Manufacturing Controls	Ineffective methods that are used by the Production Approval Holder to control product quality by statistical methods, and that may be used for continuous improvement and/or product acceptance. Statistical Quality Control includes techniques such as statistical sampling, PRE-control, and statistical process control.
		Ineffective control of precision measuring devices (for example, tools, scales, gauges, fixtures, instruments, and automated measuring machines) used in fabrication, special processing, inspection, test of detail parts, assemblies, and completed products to determine conformity to approved design.
		Lack of functions that provide for static, destructive, and functional tests of production products/ parts thereof to ensure conformity to approved design.
		Ineffective methods of controlling, evaluating, and dispositioning of any product/ part thereof that does not conform to approved design.
	Supplier Control	Ineffective methods by which the production facility ensures supplier materials, parts, and services conform to approved design. The term “supplier” includes distributors.

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11.8 Appendix 8 – Malaysia Safety Performance Indicators

The following are list of high-severity and low-severity lagging SPIs that need to be implemented by applicable service providers;

Low probability / high severity	High probability / low severity
Air Traffic Service	
H1- Serious Incident (SI): Aggregate monthly serious incidents rate per 100,000 flight movements	*L1- TCAS RA: Aggregate monthly TCAS RA rate per 100,000 flight movements*
H2- Lost of Separations (LOS): Aggregate monthly lost of separations rate per 100,000 flight movements	*L2- Level Bust (LB): Aggregate monthly level bust rate per 100,000 flight movements*
H3- Runway Incursion (RINC): Aggregate monthly runway incursion rate per 100,000 flight movements	*L3- Large Height Deviation (LHD): Aggregate monthly large height deviation rate per 100,000 flight movements*
H4- Runway Excursion (REXC): Aggregate monthly runway excursion rate per 100,000 flight movements	*L4- ILS: Aggregate monthly ILS downtime rate per 100,000 hours*
	L5- DVOR: Aggregate monthly DVOR downtime rate per 100,000 hours
	L6- RSS: Aggregate monthly RSS downtime rate per 100,000 hours
	L7- AWOS: Aggregate monthly AWOS downtime rate per 100,000 hours
	L8- PAPI: Aggregate monthly PAPI downtime rate per 100,000 hours
	L9- VHF: Aggregate monthly VHF downtime rate per 100,000 hours
	L10- Go Around - Inadequate Spacing (IS): Aggregate monthly go around due to inadequate spacing rate per 100,000 flight movements
Airworthiness	
H1- MOR Incident: Aggregate monthly incident rate per 10,000 hrs maintenance.	*L1- Customer Return Product: Aggregate monthly return product rate per 1,000 release certificates.*
Aerodrome Service	
H1- Aircraft Related Ground Accident/Incident: Aggregate monthly aircraft related ground accident/incident rate per 100,000 aircraft movements	*L1- Non-Aircraft Related Accident/Incident: Aggregate monthly non-aircraft related accident/incident rate per 100,000 aircraft movements*
H2- Runway Incursion: Aggregate monthly runway incursion rate per 100,000 aircraft movements	*L2- Taxiway Incursion: Aggregate monthly taxiway incursion rate per 100,000 aircraft movements*
H3- Runway Excursion: Aggregate monthly runway excursion rate per 100,000 aircraft movements	*L3- Oil Spillage: Aggregate monthly oil spillage rate per 100,000 aircraft movements*

H4- Reported FOD on Runway: Aggregate monthly reported FOD on runway rate per 100,000 aircraft movements	*L4- Bird strike in the movement area: Aggregate monthly bird strike in the movement area rate per 100,000 aircraft movements*
	L5- Wildlife strike in the movement area: Aggregate monthly wildlife strike in the movement area rate per 100,000 aircraft movements
	L6- Wildlife sighted in the movement area: Aggregate monthly wildlife sighted in the movement area rate per 100,000 aircraft movements
	L7- Reported FOD on Taxiway: Aggregate monthly reported FOD on taxiway rate per 100,000 aircraft movements
	L8- Reported FOD on apron: Aggregate monthly reported FOD on apron rate per 100,000 aircraft movements
	L9- Runway Surface Friction Level
Flight Operations	
H-Controlled flight into terrain (CFIT): Aggregate monthly Controlled flight into terrain rate per 100,000 flight movements	*L-Abnormal runway contact (ARC): Aggregate monthly Abnormal runway contact rate per 100,000 flight movements*
H-Loss of control – Inflight (LOC-I): Aggregate monthly Loss of control – Inflight rate per 100,000 flight movements	*L-Bird strike (Bird): Aggregate monthly Bird strike rate per 100,000 flight movements*
H-Runway excursion (RE): Aggregate monthly runway excursion rate per 100,000 flight movements	*L-Collision with obstacle during take-off and landing (CTOL): Aggregate monthly Collision with obstacle during take-off and landing rate per 100,000 flight movements*
H-Runway incursion (RI): Aggregate monthly runway incursion rate per 100,000 flight movements	*L-Fuel related events (FUEL): Aggregate monthly Fuel related events rate per 100,000 flight movements*
H-Mid-air collision: Aggregate monthly mid-air collision rate per 100,000 flight movements	*L-Ground collision (GCOL): Aggregate monthly Ground collision rate per 100,000 flight movements*
	L-Loss of control – Ground (LOS-G): Aggregate monthly Loss of control rate per 100,000 flight movements
	L-Navigation errors (NAV): Aggregate monthly Navigation errors rate per 100,000 flight movements
	L-Occurrence during ground handling operations (RAMP): Aggregate monthly Occurrence during ground handling operations rate per 100,000 flight movements
	L-System/component failure or malfunction, Non-power plant (SCF-NP): Aggregate monthly System/component failure or malfunction, Non-power plant rate per 100,000 flight movements
	L-System/component failure or malfunction, Power plant (SCF-PP): Aggregate monthly System/component failure or malfunction, Power plant rate per 100,000 flight movements
	L-Unstabilised approach (UA): Aggregate monthly Unstabilised approach rate per 100,000 flight movements