ACRP

REPORT 1

AIRPORT COOPERATIVE RESEARCH PROGRAM

Sponsored by the Federal Aviation Administration

Safety Management Systems for Airports

Volume 2: Guidebook

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 1

Safety Management Systems for Airports

Volume 2: Guidebook

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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FOREWORD

By Michael R. Salamone
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This guidebook should be of interest to airport managers and others responsible for preparing and implementing safety management systems (SMS) at airports, particularly those certified under 14 CFR Part 139. The guidebook provides a comprehensive reference that will help the user understand what constitutes an airport SMS; describes its components and their interactions; and offers guidance in the planning, implementation, and operation of an airport SMS. It also provides detailed information on how to carry out each of the necessary SMS processes. This guidebook supplements *ACRP Report 1: Volume 1,* which provides an overview of SMS and explains how a systems approach to safety management can benefit both the safety and business aspects of airports.

It should be noted that this guidebook was developed prior to the issuance of final FAA guidance relating to the implementation of SMS at airports. While developed in coordination with the FAA, this guidebook is not meant to provide final guidance in response to any FAA direction subsequently issued.

An airport safety management system (SMS) provides a systematic, proactive approach to reducing the probability and severity of aircraft accidents/incidents on the airfield. ICAO has adopted a standard for SMS that has been applicable to international airports since November 2005; however, ICAO–State Letter AN12/51-07/74 proposed the amendment of Annex 14 (Vol. 1) to harmonize and extend provisions relating to safety management and included extending the date for SMS implementation to November 2009. As of this writing, the FAA is developing guidance on SMS implementation in the United States.

Airport operators in the United States have safety programs in place that have resulted in today's high level of aviation safety. These programs can form the basis of a more comprehensive SMS. An SMS will supplement these programs by providing a systematic, proactive approach that includes (1) documenting identified hazards and mitigating potential risks; (2) monitoring and measuring the ongoing safety experience of the airport; (3) establishing a voluntary non-punitive safety reporting system that can be used by employees of the airport operator, airlines, and tenants; and (4) improving the entire airport's safety culture. A key component of an SMS is safety risk management (SRM) that is used to classify potential airport risks according to their probabilities of occurrence and severity of consequences, to prioritize those risks according to their classification, and to define risk mitigating actions that are continuously monitored.

Under ACRP Project 4-05, Applied Research Associates was asked to create a guidebook for developing and implementing airport safety management systems (SMS). The guidebook was to be applicable to all airports that have certificates issued under 14 Code of Federal Regulations (CFR) Part 139, Certification of Airports and should describe the associ-

ated concepts, methodologies, processes, tools, and safety performance measurements that can be applied by airports based on their level of operations and complexity.

To accomplish the project objectives, the research team (1) conducted a literature review to document best SMS practices that are applicable to airports; (2) surveyed airports to determine their current safety practices, procedures, and programs that may form the basis of an SMS; (3) conducted a gap analysis to determine what deficiencies exist in current programs from an SMS perspective and categorized the gaps according to the four elements of SMS: (a) safety policy and objectives, (b) safety risk management, (c) safety assurance, and (d) safety promotion; (4) drafted the guidebook with examples and best practices applicable to airports of various types and complexities; (5) obtained comments on clarity, applicability, and usefulness of the draft guidebook from managers of a diverse group of airports certificated under 14 CFR Part 139; and (6) prepared a final guidebook based on the industry feedback obtained.

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CHAPTER 1

Introduction

1.1 Objective

This document is designed to assist 14 CFR Part 139 airport operators with the development and implementation of safety management systems (SMS) for their airports. The information provided is not intended as a prescriptive formula for the development of an airport's SMS, nor is it a procedure or template for building SMS documentation. It is a practical reference to provide objective guidance on how to develop SMS processes and create the system.

The material contained herein is for explanatory purposes only. Where existing systems or pillars have been referenced, the example is used for the purpose of clarity and to demonstrate that there are existing systems available. It is not the intention of the authors to advocate that any one particular system be used. In keeping with performance-based regulations, this guidebook is intended to provide details of the various SMS requirements and to offer examples of possible ways these elements can be enabled.

It is assumed that the user has a basic understanding of SMS and Part 139 requirements and is familiar with the following:

- Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5200-37—Introduction to Safety Management Systems for Airport Operators[1]
- *ACRP Report 1: Overview of Safety Management Systems for Airports*[2]
- International Civil Aviation Organization (ICAO) Doc 9859—Safety Management Manual (SMM)[3]

1.2 How to Use This Guidebook

Implementing an SMS will require a phased approach, with each phase building on previous steps. This guidebook is organized chronologically according to those phases. Chapter 1 provides some definitions and acronyms used throughout the text. Chapter 2 helps the reader identify some basic SMS concepts, pillars and elements of an airport SMS, and how these building blocks work and interact to improve the safety culture and, ultimately, the overall safety of airport activities. Moreover, this chapter responds to some basic questions that airport operators face before developing an SMS program.

Chapter 3 will help you get started with SMS. The objective of this chapter is to help you plan and design your airport SMS, from identifying the resources that are already in place to choosing the best SMS architecture for the airport. This section will help you identify and conduct each step of the SMS planning and design.

Chapter 4 is intended to guide airport management through the initial transition to SMS. This chapter will introduce you to best practices and the steps needed to implement your SMS. You will learn how to document and develop a structured implementation plan to gradually bring your SMS to operation.

Chapter 5 describes the five phases of safety risk management (SRM), which is the key process behind safety management. This chapter also presents a step-by-step example of the process using typical airport hazards.

Chapter 6 contains information to help you operate your SMS. It describes the tools, approaches, procedures, techniques, and methods that support the operation of an airport SMS.

The annexes provide additional support materials. For example, the gap analysis and SMS assessment tables are included in Annex A[(1),(3),(4)].

Each chapter includes some common elements to help the reader understand important concepts or to highlight specific issues:

Example		**Illustrative example to help understand the concept**
Scalability		**Depends on the size and complexity of the airport**
Hint		**Practical suggestion and useful approach**
Caution		**Potential bottlenecks and practical ways to overcome them**
Key		**Important point for consideration, sometimes in the form of a citation**

It is recommended that readers follow the order that the subjects are presented in this guidebook, as it intentionally follows the SMS structure described in the FAA AC 150/5200-37[(1)].

1.3 Definitions

The following terms are used throughout this report:

Accident: An unplanned event or series of events resulting in death, injury, or damage to, or loss of, equipment or property.

Audit: Formal reviews and verifications to evaluate conformity with policy, standards, and contractual requirements.

— **Internal Audit:** An audit conducted by, or on behalf of, the organization being audited.
— **External Audit:** An audit conducted by an entity outside the organization being audited.

Beliefs: The conviction (real or perceived) that certain facts and/or actions will entail specific consequences; how people think things work. An example is the belief, "I will not get penalized if I delay the job for safety reasons." There are beliefs that promote a strong safety culture and others that undermine it.

Beliefs that may promote or undermine safety

Promote
- *My supervisor is really committed to safety*
- *Most accidents are caused by human factors*
- *Incidents are valuable learning experiences and should be reported*

Undermine
- *Sometimes it is necessary to take chances to get a job done*
- *Sometimes it is necessary to turn a blind eye when safety rules are broken*
- *My manager says "safety first" but doesn't really mean it*

Consequence: Potential outcome(s) of a hazard.

Corrective Action: Action to eliminate or mitigate the cause or reduce the effects of a detected nonconformity or other undesirable situation.

Culture: Workplace culture is the set of shared values and beliefs of people in an organization. Culture encourages certain behaviors and discourages others.

Documentation: Information or meaningful data and supporting medium (e.g., paper, electronic). In this context, it is distinct from records because it is the written description of policies, processes, procedures, objectives, requirements, authorities, responsibilities, or work instructions.

Errors: In the present context, an error is an "honest mistake" that is unintentional, not out of malicious intent, and not a result of gross negligence. There are legal definitions of the term "gross negligence," but it is not the intent of this guidebook to debate this issue.

"Human error is a symptom, not a cause."
(*James Reason*[5])

Gap Analysis: Identification of existing safety pillars compared with SMS program requirements. Gap analysis provides an airport operator an initial SMS development plan.

Hazard: Any existing or potential condition that can lead to injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a prerequisite to an accident or incident.

A runway contaminated with ice is a *hazard.*

The potential that the pilot may not be able to control the aircraft during the operation and veer off or overrun the runway, causing hull loss and multiple fatalities is the *risk.*

Incident: A near miss episode, malfunction, or failure without accident-level consequences that has a significant chance of resulting in accident-level consequences.

Investigation: A process conducted for the purpose of accident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of causes and, when appropriate, the making of safety recommendations.

Latent Conditions: existent conditions in the system that can be triggered by an event or a set of events[3] or "latent errors, whose adverse consequences may lie dormant within the system for a long time."[4]

Likelihood: The estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect.

Line Management: Management structure that operates the production/operational system.

Near Miss: "Any event that could have had bad consequences, but did not."[31]

Nonconformity: Non-fulfillment of a requirement. This includes but is not limited to non-compliance with federal regulations. It also includes an organization's requirements, policies, and procedures, as well as requirements of safety risk controls developed by the organization.

Oversight: A function that ensures the effective promulgation and implementation of safety standards, requirements, regulations, and associated procedures. Safety oversight also ensures that the acceptable level of safety risk is not exceeded in the air transportation system.

Procedure: A specified way to carry out an activity or a process.

Process: A set of interrelated or interacting activities that transforms inputs into outputs.

Proximate Cause: A cause that, in a natural and continuous sequence, unbroken by new and independent causes, produces the injury.

Records: Evidence of results achieved or activities performed. In this context, it is distinct from documentation because records are the documentation of SMS outputs.

Risk Assessment: Assessment of the system or pillar to compare the achieved risk level with the tolerable risk level.

Root Cause: A factor (event, condition, organizational) that contributed to or created the proximate cause and subsequent undesired outcome and, if eliminated or modified, would have prevented the undesired outcome. Typically, multiple root causes contribute to an undesired outcome.

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

Safety Assessment: A systematic, comprehensive evaluation of an implemented system.

Safety Assurance: SMS process management functions that systematically provide confidence that organizational products/services meet or exceed safety requirements.

Safety Climate: The manifestation of safety culture in the behavior and expressed attitude of employees.

Safety Culture: The product of individual and group values, attitudes, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, the organization's management of safety. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures.

Safety Management System: The formal, top-down business-like approach to managing safety risk. It includes systematic procedures, practices, and policies for the management of safety (including safety risk management, safety policy, safety assurance, and safety promotion).

Safety Objective: Safety goals or desired outcomes, which typically are measurable.

Safety Performance Indicator: Any measurable parameter used to point out how well any activity related to safety is performing over time, and to assess the overall SMS health indirectly.

Safety Policy: Defines the fundamental approach to managing safety that is to be adopted within an organization. Safety policy further defines the organization's commitment to safety and overall safety vision.

Safety Promotion: A combination of safety culture, training, and information sharing activities that supports the implementation and operation of an SMS in an organization.

Safety Risk: The composite of the likelihood (i.e., probability) of the potential effect of a hazard and predicted severity of that effect. As an example, an overshoot by an aircraft landing on an icy runway would be considered a safety risk of the hazard. The hazard is "icy runway," and the risk is "an overshoot."

Safety Risk Control: Anything that mitigates the safety risk of a hazard. Safety risk controls necessary to mitigate an unacceptable risk should be mandatory, measurable, and monitored for effectiveness.

Safety Risk Management: A formal process within the SMS composed of describing the system, identifying the hazards and assessing, analyzing, and controlling the risk. The SRM process is embedded in the operational system; it is not a separate process.

Severity: The consequence or impact of a hazard in terms of degree of loss or harm.

System: An integrated set of elements that are combined in an operational or support environment to accomplish a defined objective. These elements include people, hardware, software, firmware, information, procedures, facilities, services, and environment.

Top Management: The person or group of people who direct and control an organization. This group is sometimes referred to as Senior Management.

Unsafe Behavior: A behavior that is more likely to lead to incidents or accidents. An unsafe behavior may be unintentional or intentional.

In 2005, a ground baggage handler grazed an MD-83 aircraft with a tug while attempting to depart the vicinity of the airplane. The incident was triggered by improper operation (the unsafe behavior) and was not reported (an amplification factor also indicative of an unsafe behavior). The damage to the aircraft was substantial. The result was the aircraft's in-flight depressurization. Post landing examination of the fuselage revealed a 12 by 6-inch hole on the right side of the airplane (source: NTSB SEA06LA033).

Values: Those principles, concepts, and ideas that people think are important. Safety is an example of a value.

Worst Credible Condition: The most unfavorable conditions or combination of conditions that are reasonably expected to occur.

1.4 Abbreviations and Acronyms

AC	Advisory Circular
ACM	Airport Certification Manual
ACRP	Airport Cooperative Research Program
AEP	Airport Emergency Plan
AIP	Aeronautical Information Publication
ALARP	As Low As Reasonably Practicable
AOA	Airport Operations Area
ARFF	Aircraft Rescue and Fire Fighting
ATC	Air Traffic Control
CEO	Chief Executive Officer
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FOD	Foreign Object Damage or Foreign Object Debris
FOIA	Freedom of Information Act
ICAO	International Civil Aviation Organization
ISO	International Organization for Standardization
NAS	National Airspace System
NAVAID	Navigational Aid
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
OSHA	Occupational Safety and Health Administration
PDCA	Plan-Do-Check-Act
PCN	Pavement Classification Number
PPE	Personal Protective Equipment
SAT	Systems Approach to Training
SIDA	Security Identification Display Areas
SMGCS	Surface Movement Guidance and Control System
SMM	Safety Management Manual
SMS	Safety Management System
SOP	Standard Operating Procedure
SPI	Safety Performance Indicator
SRM	Safety Risk Management

CHAPTER 2

Airport Safety Management Systems

The aviation industry has always quoted safety at the forefront of its priorities, and as a general rule, has demonstrated diligence in learning from its mistakes and implementing changes that lead to further improvement. This somewhat reactive approach produced a steady decline in accident rates until the mid-1980s. Since then, the fatal accident rate in air transport operations has remained fairly stable, despite a growth in traffic during the same period. This trend implies little improvement in safety on the operation/accident ratio and suggests that as traffic grows, the total number of accidents will also grow.

The ICAO[6], recognizing these facts and that "the public's perception of aviation safety is largely based on the number of aircraft accidents rather than the accident rate,"[7] issued a resolution to "reduce the numbers of accidents and fatalities irrespective of the volumes of air traffic."[8] The ICAO further provides guidance on how to achieve this resolution, including the recommendation to "develop a civil aviation safety management framework and recommendations for improving safety."[7]

In recent years a great deal of effort has been devoted to understanding how accidents happen. It is generally accepted that most accidents result from human error. It would be easy to conclude that these human errors indicate carelessness or lack of skills on the job, but such a statement is not accurate. Accident investigators are finding that the human error is only the last link in a chain that leads to an accident. Accidents cannot be prevented by changing people; they can be prevented only when we address the underlying causal factors.

There are two ways to think about safety. The traditional way is that safety has been about avoiding costs. In this sense, many aviation organizations have been bankrupted by the cost of a single major accident. This makes a strong case for safety, but the cost of occurrences is only part of the story. Efficiency is the second way of thinking about safety. Research has shown that safety and efficiency are positively linked. Safety pays off in reduced losses, enhanced productivity, and lower insurance costs. In 2006, the Port of Seattle opened a ramp tower to assist with ramp operations and improve safety and efficiency. The Port's insurance company agreed that the liability had been reduced due to the ramp tower and lowered the insurance costs. This is an excellent example of how safety, efficiency, and costs are linked.

An SMS will provide an airport with the capacity to anticipate and address safety issues before they lead to an incident or accident. An SMS also provides management with the ability to deal effectively with accidents and near misses so that valuable lessons are applied to improve safety and efficiency. The SMS approach reduces losses, improves productivity, and is generally good for business.

Airports are key parts of the aviation industry, together with the airlines, air traffic organizations, and aviation service providers. Accident rates can decrease only if each of these parts takes

initiatives to improve safety. SMS provides a link between the safety professionals (focused on accident prevention) and the operators (focused on production). This teaming is vital for safety improvement.

In the future, it is likely that the FAA will require certain airports to have an SMS. However, whether required or not, it is still a good idea for every airport to have one.

SMS can reduce costs and keep up the airport's good reputation. SMS can help develop a positive safety culture and reduce the rate of fatal accidents in the aviation industry.

2.1 What Is SMS?

According to FAA AC 150/5200-37 (2007),[1] SMS is "the formal, top-down business-like approach to managing safety risk. It includes systematic procedures, practices, and policies for the management of safety (including safety risk management, safety policy, safety assurance, and safety promotion)." SMS is a tool to translate an organization's concerns about safety into effective actions to mitigate hazards. It is a documented system that encompasses the following:

- A safety policy incorporating responsibilities for everyone working at the airport and the airport's safety objectives
- Effective decision tools for managers when dealing with safety issues
- A program for identifying training needs, training, assessing competency, and keeping records of training performed
- A framework for involving employees in the management of safety
- The collection, analysis, and reporting of safety performance data
- The identification of hazards in the airport
- The assessment of the risk that the hazards identified pose to airport activities
- The elimination or control of identified risks
- An evaluation of the effectiveness of control measures
- Arrangements for emergency preparedness and response
- Arrangements to improve safety awareness and to promote safety
- Documentation of meetings, decisions, actions, and other SMS-related activities or processes
- Systems for monitoring the safety performance of the airport
- Systems for the reporting and investigating accidents/incidents
- Processes that elevate safety reporting and safety decision making to top management levels of the organization
- Other aspects common to management systems, such as safety committees, document and records control, internal auditing, and management review meetings

According to R. González (ICAO), "A rapidly expanding industry and its increasing complexity make it difficult to sustain an approach to safety exclusively based upon regulatory compliance. It is essential to complement the regulatory approach to safety with a proactive approach. SMS is also the most effective way of responding to the need for results-based supervision with a relatively small workforce."[9]

The following sections present a general SMS framework, including a short description of each SMS pillar and element.

When we speak of the elements of an SMS, each is required in some way, regardless of the size and complexity of the airport. It is the extent or detail of the element that needs to be tailored to the airport operation.

When putting an SMS in place, it must be customized so that it suits your airport. It cannot be done by following a prescription. What is most important, in the final analysis, is that each pillar is effective, not merely present.

2.2 Pillars and Elements of an SMS

The four basic SMS pillars (components) described in FAA AC 150/5200-37[1] are represented in Figure 1: policies and objectives, safety risk management, safety assurance, and safety promotion. Each pillar includes several elements, each of which represents a specific SMS function that is important for the system. This structure serves to organize the SMS functions and make it easier to understand.

This guidebook is organized according to the model presented in Figure 1; however, your airport can use a different one if that is more appropriate for your specific conditions. For example, in Australia[10],[11], SMS has been mandatory for certificated airports since 2007, and it is recommended that they use eight elements. There are no missing elements in the Australian recommendations; they simply combine two or more of the functions into one element.

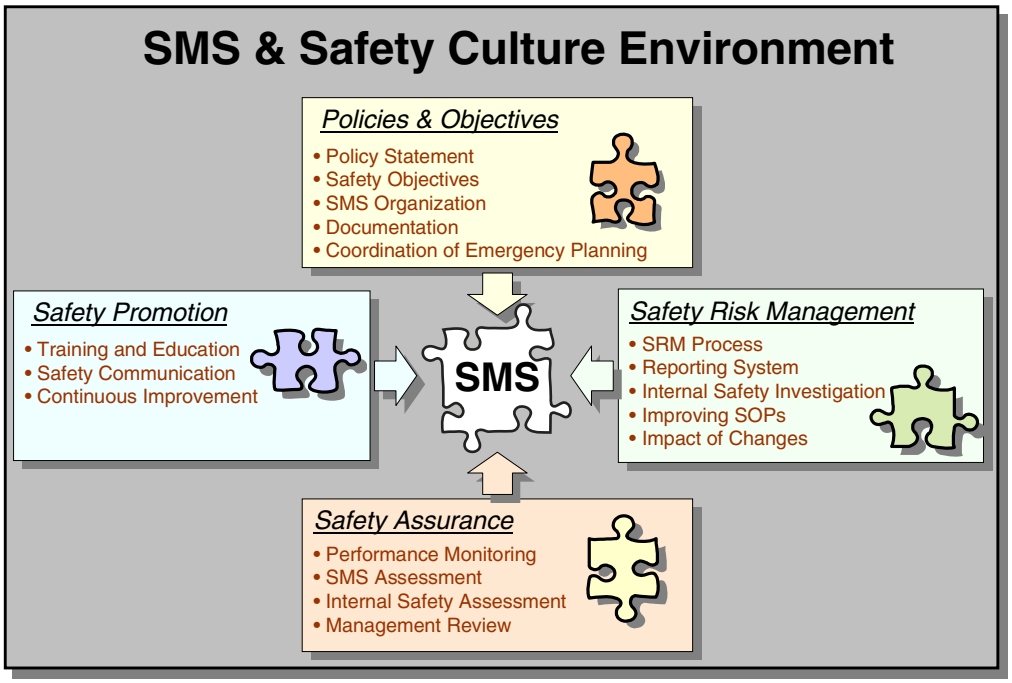


Figure 1. The pillars and elements of SMS.

Binding these pillars and elements together contributes to developing a positive safety culture in the airport organization. With an effective SMS it will be easier for the airport to develop a positive safety culture, and at the same time, a positive safety culture will help develop an effective SMS. The system is limited by the boundaries of its scope, as represented by the gray rectangle in Figure 1. These boundaries may or not be physical limits (e.g., airside).

Pillar 1—Safety Policy and Objectives

Management can support SMS by setting the safety standards and policies for the airport organization, encouraging participation in the SMS process, facilitating the flow of information, and supporting safety objectives by allocating the required resources.

Safety Policy Statement

What Is It? A safety policy establishes the direction and sets the "principles of action" for the airport organization, with respect to safety. It articulates the vision of who you are and how you behave as an organization.

What Should It Achieve? Policy is management's vehicle to communicate its intentions and commitment to safe operations and continuous improvement. By reading this policy, all staff should be able to identify and understand that safety is a priority for management and is expected to be a priority for them as well.

How Do We Address It? You should have a safety policy that outlines how safety is viewed within your airport, and how it is considered as part of operations. Section 4.2 of this guidebook will help you develop a safety policy for your airport.

Safety Objectives

What Is It? As policy describes the organization's overall approach to safety, objectives identify specific outcomes that SMS is trying to achieve. Generally speaking, an objective is a desired end point to a specific activity or process, in this case, safety processes. Usually, an organization will want to achieve objectives within a finite period of time and will set deadlines for each objective.

An airport operator might decide to install a stop bar system in all runway access points to reduce the risk of runway incursions in the next 5 years.

Objectives that may take a long time to achieve, or that require complex solutions, often will have a series of associated intermediate goals. Goals identify interim achievements that support the accomplishment of an objective. Both objectives and goals should be measurable (quantitative vs. qualitative) so that progress can be measured.

What Should It Achieve? Safety objectives give individuals and the organization measurable targets to work toward. They provide direction and guidance for safety management activities. Once the SMS is up and running, safety objectives should be linked to identify risks and used as a basis for performance measurement.

How Do We Address It? Organizational safety objectives should be based on the risk associated with operational activities and make sense, when compared with the safety policy. National and international industry objectives should also be respected. In other words, when the FAA makes a commitment to achieve a certain level of safety, or address a specific industry trend, the airport's objectives should relate to these national-level objectives.

Organizational objectives (high-level) should be supported by departmental or divisional safety objectives. This way, every group within the airport organization is helping to meet organizational safety objectives.

More discussion on safety objectives and examples are presented in Section 4.2 of this guidebook.

An airport sets the objective to reduce runway incursions by 25% over the next 2 years. In support of this organizational objective, the airfield maintenance department may set its own objective that all their personnel must attend refresher airport operations area (AOA) driving training every 6 months.

SMS Organization

SMS Organization refers to the appointment of key aviation safety personnel, the definition of safety accountability, and the organization of safety committees. Each of these three processes should be documented.

Appointment of Key Aviation Safety Personnel

What Is It? This element calls for the identification of key personnel to manage SMS processes. The goal is to have a team (one or more people, depending on the size of the airport organization) of professionals who will support the development, implementation, and monitoring of safety issues and processes across the organization. This team should be designated to conduct the implementation and to operate the SMS when it is in place.

What Should It Achieve? This element ensures that the implementation and coordination of SMS is administered, monitored, and supported on a daily basis, ensuring the continuity of safety programs and processes throughout the airport organization. The appointed person/team should function as the SMS "champion": coordinate and promote special programs; support line management in daily activities; and collect, analyze, and feed back data.

How Do We Address It? The specific functions that need to be defined and filled will depend on the airport. However, there should be at least one qualified person to oversee the operation of the SMS (the SMS Manager). This person should have experience in the operational field, a good understanding of SMS, a good understanding of how the organization works, and access to top management for safety issues. It also helps if the individual is approachable and able to relate to both management and line personnel. Required qualifications for this function are presented in Section 4.3.

It is important to note that the specific airport organization will determine how these functions are fulfilled. At larger airports, it is possible that one or more new positions may be created, if that is feasible. At smaller airports, these functions should be assigned to existing employees and new positions should not be created.

Avoid using the title Safety Manager because it supports the perception that safety is managed by a specific individual or department. Safety is a line responsibility, and everyone has a role to play. Therefore, the title SMS Manager or Safety Coordinator is more appropriate to the intended role.

Key aviation safety personnel should be included formally on the airport's organization chart, so that everyone knows who they are and where they fit within the organizational hierarchy. Identify functional reporting and lines of communication, including how this person/group will access top management (e.g., committee, board meetings). Aim for independence from other functional departments to avoid conflict of interest in decision making; for example, at larger airports, whenever possible, do not make the Operations Manager also responsible for SMS, and do not have the SMS Manager report directly to the Operations Manager.

Independence from other functional departments normally is possible in large airports but may not be possible or appropriate in smaller ones. In any case, it is imperative that the lines of communication between top management and the SMS Manager be as open and fluid as possible.

Safety Accountability

What Is It? A clear safety policy and defined objectives set direction and identify what the organization wants to achieve through safety management activities. The actions and behavior of personnel will lead to the accomplishment of these objectives. Therefore, the roles, responsibilities, and authorities of personnel who manage, perform, and verify activities that have an effect on aviation safety should be identified and included in the SMS documentation.

The difference between accountability and responsibility often is confused.

Accountability cannot be delegated. It represents the person who ultimately is responsible for the success, failure, or conduct of an activity.

Responsibility can be delegated. A person may be assigned a task and be responsible for completing or achieving that task or objective. The individual may be accountable to a superior for completing that task, but it usually is the superior who is accountable for the outcome.

What Should It Achieve? Safety responsibilities should flow both top-down and bottom-up, because this contributes to the development of a positive safety culture. All personnel should be aware of their roles and responsibilities with respect to safety management and take ownership for their actions and behavior.

How Do We Address It? An Accountable Executive* should be identified as ultimately responsible for the safety of personnel, business processes, and activities of the airport organization. Therefore, this should be the person at the top of the organization. This person should demonstrate a commitment to safety by allocating the resources necessary to achieve organizational safety objectives.

*Although the term "Accountable Executive" is used in this document, there are a number of different titles used for the same position with similar associated responsibilities. For example, "Accountable Manager" also can be used. It is not the title, but the concept that is important.

The Accountable Executive should have the following:

- Full authority for human resource issues
- Full authority for major financial issues
- Responsibility to manage all areas involved in the SMS
- Responsibility for all safety issues
- Responsibility for the airport activities

The authority of the Accountable Executive should cover all activities under the SMS scope.

Depending on the size of the organization, the Accountable Executive could delegate a lot of the responsibility for safety to other managers.

In a large airport, for example, day-to-day management of SMS processes could be the responsibility of the SMS Manager, with monthly updates to the Manager of Operations, but the Accountable Executive could actually be the Airport Manager, who receives quarterly updates and a full briefing after the SMS management review (see Pillar 3—Safety Assurance).

In a very small airport, the Airport Manager may also take on the role of SMS Manager and actively manage safety processes and performance.

In practice, safety is a line responsibility. Functional managers (e.g., the Operations Manager) should be responsible for safety within their own department. All personnel and groups should be involved in the SMS, thereby fostering an airportwide commitment to safety management.

The roles and responsibilities of personnel at all levels should be defined clearly in the airport documentation, such as the SMS manual or job descriptions. The responsibilities of certain positions (not necessarily names), such as the SMS Manager, may be identified in the safety policy.

Safety Committees

What Is It? The Safety Committee is a group appointed by the Accountable Executive to provide a forum to discuss issues related to the safety performance of the airport and the health of the SMS.

What Should It Achieve? The committee can be created to provide recommendations concerning safety issues. These may include making policy decisions, reviewing safety performance results, reviewing SMS implementation progress, providing expert advice to mitigate specific problems (e.g., improve ramp safety), providing support and advice to the SMS operation, reviewing the development of standard operating procedures, creating safety awareness programs, and developing coordination of airport work.

How Do We Address It? The Accountable Executive should formally appoint the members of the airport safety committee, and regular meetings should be held to discuss issues, develop decisions, define actions, establish responsibility for the actions, and define a timeframe. The terms of reference and meeting discussions for each committee should be documented.

Safety Committees may not be necessary at smaller airports. Small committees may be created on an ad hoc basis to deal with specific safety issues. In this case, only a few members representing airport parties would be sufficient to make a joint decision, sometimes with the help of an external source of advice.

Documentation

What Is It? Every airport operates according to specific policies, processes, procedures, and practices. These generally are communicated through written forms, manuals, and other publications. Documentation includes all written materials that contain information or records required to conduct business. The airport documentation goes beyond the SMS documentation; it may include documents required under Part 139, state and municipal laws, and so forth.

What Should It Achieve? Written materials support continuity and standardization of organizational processes. They also develop and maintain essential "corporate memory" and help an airport meet legal requirements to maintain current and effective safety information.

An efficient documentation management system should maintain current and adequate published documents, as well as enable auditing of documents from creation to withdrawal.

How Do We Address It? To control a document throughout its life cycle, an airport should develop and implement processes that will manage documentation creation, receipt, maintenance, use, and disposal/archive. The documentation processes should address the following:

- Legal and other requirements
- SMS documentation
- Documentation and data control
- Records management

Legal and Other Requirements

Certificated airports operate within a regulated environment. Keeping up to date with these regulations ensures compliance and allows the airport to benefit from best practices and industry lessons learned that are reflected in these requirements. It is important to note that not all safety issues are identified and mitigated based only on regulations.

What Is It? SMS requires a system or documented procedure that (1) identifies applicable federal, state, county, and municipal regulatory requirements and standards for the airport and (2) tracks changes and revisions. This system should also include a procedure for distribution of information to those that need it. Please note that control of such legal requirements should not be restricted to Part 139 regulations; it should include every regulation applicable to the airport.

What Should It Achieve? This process ensures that changes in legal requirements and standards are included in existing organizational manuals, procedures, and practices.

A person is delegated to check government websites regularly for legislation changes, participate in industry working groups involved in the development of regulations, and so forth.

How Do We Address It? Implement a procedure for the systematic identification of all regulations and standards that the organization must follow. Annex D contains a list of legal references for certificated airports.

Ensure that information is distributed and shared with those people whose jobs are affected by changes or updates. One way of doing this is to store legal information in a centralized location, such as a corporate library or intranet website.

SMS Information Control

Information control refers to the management of safety-related documentation, including manuals, standard operating procedures (SOP), forms, memoranda, minutes of meetings, reports, and so on. It also encompasses management of safety data and records, which in an SMS context usually refers to information gathered to measure safety performance and safety-related records (e.g., training records).

What Is It? This element requires a process to generate, collect, analyze, store, distribute, retrieve, and dispose or archive documents, data and records. It should be applied consistently throughout the organization.

What Should It Achieve? It should ensure that current versions of relevant documents are available at the locations where they are needed. It should also identify changes that can affect documents already issued, as well as ensure that obsolete documents and data are removed promptly from all locations to prevent unintended use. Information should be processed so that it can be retrieved easily and used to perform trend analysis and as input to management reviews.

A safety information control system should also allow for reliable and easy identification, maintenance, and disposal of safety-significant information, including information needed to conduct hazard identification, event investigation, and safety performance measurement processes. It also proves that activities have taken place, such as mandatory training, and serves as evidence for accident investigations and external audits.

How Do We Address It? Ensure that the documents are structured, cross-referenced, and coordinated, so that changes to any of them are reflected wherever appropriate in the other documents. Establish procedures for document control (who can issue them, who can approve them, etc.). Make sure that the documents are reviewed periodically, revised as necessary, and approved by authorized personnel. To achieve this, set a frequency for the revision of key documents, and make sure that documents include a revision date as a reference.

The process should also include the identification of all documents that need to be present to respond to regulatory requirements. Then, develop a management system that includes the control processes necessary to ensure appropriate identification, legibility, storage, protection,

There are many web-based and software tools that provide basic data and record management systems capability, and they can be quite effective if an airport is limited in the amount of resources it has to develop, manage, and maintain a documentation management system.

For smaller airports, software tools may not be practical. A simple table cross-referencing documents can be useful, and it should show what documents may have to be revised as the result of a change in another document.

archiving, retrieval, retention time, and disposition of data and records. Ensure that this system allows for easy retrieval and prevents data and records from being easily lost or deleted. It is important that only appropriate personnel have access to safety databases, and that these people receive the necessary training for using and maintaining safety information management systems.

There are several ways of keeping documents up to date. It does not matter which one is used, provided that it is used consistently by all.

A very common, although not very efficient, system is one where new pages are distributed and individuals have to replace them in their own copy of the document. If this method is used, emphasize how important it is that personnel actually make the updates.

The International Standards Organization (ISO) defines records as "information created, received, and maintained as evidence."[12] Records show that something has taken place, and they do not change over time (unlike documents, which can be revised). Therefore, records management is "the efficient and systematic control of the creation, receipt, maintenance, use and disposition of records, including the processes for capturing and maintaining evidence."[12]

Records may have legal implications

For airport operators, certain documents pertaining to daily activities are required by regulations, such as physical inspections of the movement area. These records may be reviewed and analyzed in the case of an aircraft accident, for example. In this case, keeping such records is a regulatory requirement for Part 139 airports.

Using these records as part of the SMS process may help the airport clarify the root causes of such accidents.

Whether a large or a small operator, there is a need to get reports, keep track of the data in those reports, and monitor and analyze trends. This information will be the foundation for a safety database. Depending on the size of the organization, this database could be done in written or electronic form.

A small airport may keep its training records in a spreadsheet developed by the SMS Manager.

Coordination of Emergency Planning

What Is It? Every airport is subject to emergencies. An airport emergency is a situation that warrants action to save lives and to protect property and public health. It is very unlikely that an airport has sufficient resources to respond to every emergency situation independently; each airport must depend to some degree on the resources from its surrounding communities. It is essential to prepare for emergencies that face an airport so that it can respond quickly, efficiently, and effectively. The use of SRM to evaluate deficiencies in coordination and procedures of emergency planning can help improve the Airport Emergency Plan (AEP).

What Should It Achieve? Strong emergency preparedness planning and training can assist in limiting the negative impact of accidents, including liability and other post-emergency issues.

How Do We Address It? The airport should develop an emergency plan in accordance with AC 150/5200-31—Airport Emergency Plan, and the requirements in 14 CFR Part 139.325. The plan assigns responsibility to organizations and individuals for carrying out specific actions at projected times and places in responding to an emergency. The SRM process can help identify deficiencies and hazards that threaten the coordination, response time, or procedures for an effective emergency plan. Moreover, SMS will assist identifying and prioritizing the actions to improve the plan.

The AEP is a Part 139 requirement for certificated airports, and SMS processes may help your airport improve the plan. Using the SMS approach, airport staff will be able to identify hazards and risks that are not described in the AEP and prioritize improvements to the emergency plan to make it even more effective. As with everything related to safety, SMS will support and sustain a strong safety culture that certainly will improve the effectiveness of the AEP.

Pillar 2—Safety Risk Management

What can go wrong, and what do we do about it?

An SMS improves safety by managing risk proactively. Identifying hazards and systematically assessing the associated risk in terms of likelihood and severity provides managers with a structured, disciplined way to assess risk. Control measures are then used to reduce risk to an acceptable level. Section 5.7 provides a step-by-step example of SRM for airports.

Safety Risk Management Process

SRM is a fundamental decision-making pillar of the SMS. It is a systematic, explicit, and comprehensive approach for managing safety risk at all levels and throughout the entire scope of an operation and lifecycle of a system. It requires the disciplined assessment and management of safety risk.

The SRM process ensures that hazards are identified and tracked to resolution; safety-related changes are documented; risk is assessed and analyzed; unacceptable risk is mitigated; the effectiveness of risk mitigation strategies is assessed; and changes/improvements to mitigate risk are monitored throughout their lifecycle. The SRM process comprises five steps:

1. Describe the system or activity
2. Identify the hazards along the activity path
3. Determine the risk
4. Assess and analyze the risk
5. Treat and monitor the risk

Chapter 5 contains several examples of airport hazards and risks and explains how to proceed with the SRM process.

Step 1—Describe the System or Activity

What Is It? The first step sets the boundaries of your analysis and has you break down your operations and list all the activities associated with each of them. Such boundaries can be physical, organizational, or defined by a specific activity.

What Should It Achieve? It provides a systematic and comprehensive process to identify all safety-significant activities performed by the organization within the system that has been identified.

How Do We Address It? Brainstorming sessions with different levels of personnel within each department are one of the most successful ways to obtain effective results.

Physical Boundaries: Apron D

Organizational Boundaries: Maintenance Section

Activity Boundaries: Construction of perimeter taxiways

List of activities during construction of perimeter taxiways:

- Access to construction site
- Equipment parking
- Construction debris in operational areas
- Marking and lighting of construction areas
- Other

Step 2—Identify the Hazards

What Is It? A hazard is an event or situation that, given certain conditions, could potentially cause injury or damage. The hazard identification process allows you to identify these situations and take action. The key to hazard identification is to ask yourself or others what things you see could lead to accidents.

What Should It Achieve? This allows you to become aware of what and where the hazards associated with the activity are, so that you can take a proactive approach toward controlling them before an incident or accident occurs. It should also facilitate the development of an attitude that promotes the recognition and communication of potential safety issues at all levels.

How Do We Address It? Determine how you will identify hazards within your organization. There are many different ways to do this. The method you choose will depend on the scale and scope of analysis that you are conducting. Different approaches may be appropriate based on available resources.

There are several ways to go about identifying hazards. For example, you could hold a workshop with employees from the targeted areas (employees are the most familiar with their working environment), in which brainstorming sessions could take place. You can also use checklists or audit forms, analyze records and trends, conduct scenario analysis, etc.

Type Specific—These are only a few examples of where to look for airport hazards. A more comprehensive list is presented in Chapter 5.

Aircraft ground activities	Airside vehicles
Airport construction	Parking facilities
Birds and wildlife	Access roads

Two common dynamic means to identify hazards are self-inspections and hazard reporting systems. The first one is a Part 139 requirement and is very effective for identifying hazards in the airfield. In this case, safety information should constantly be submitted to the SMS Manager. Hazard reporting systems can also be very effective and may cover the entire airport facility. In this latter case, the information can be passed directly or indirectly to the SMS Manager.

Step 3—Determine the Risk

What Is It? Once hazards have been identified, the next step is to determine and define the risks associated with each hazard.

What Should It Achieve? This element should provide you with a list of risks that your organization faces.

How Do We Address It? Once you know the hazard, ask yourself what could go wrong. Look at all the possibilities, even the ones that seem far-fetched. Then ask, what would be the impacts of the hazard? Technically speaking, we are not yet talking about the level of risk. This is all about consequences. The level of risk is covered in the next section.

For example, during an airfield inspection after a rain, you find out that your runway holding position markings are not very clear when the pavement is wet. That is a hazard and in this step you can determine that the risk is a runway incursion and collision with another aircraft using the runway; this is where you stop in this phase. It is important to note that each hazard must be associated with at least one risk that it is reasonable to expect will occur; however, it is also common that one hazard is associated with two or more credible risks.

Step 4—Assess and Analyze the Risk

What Is It? Risk is the potential ability of a hazard to result in injury or damage. Risk assessment is a procedure used to measure the probability of this happening and the consequences that can be expected should it happen.

What Should It Achieve? On a practical level, risk assessment should allow you to prioritize the risks identified in Step 3, so that airport resources can be focused on addressing the risks with the potential for higher impact. On a higher level, it can be used to support a risk-based management approach toward everything that is done within the organization. This approach should be done formally, at the organizational level, and informally, as part of the way individuals do their jobs.

How Do We Address It? In the risk assessment process, be sure to include a definition of the criteria for classifying the risks, when control measures should be implemented, and the events that will trigger a risk assessment. There are several tools available to help classify risk, including various software programs. Select a tool that will work for you. Additional information is found in Section 5.5.

Most airport hazards can be evaluated using a simple methodology: the risk matrix; however, more complex methodologies may be needed, particularly when analyzing the impact of major changes (e.g., airport improvement projects). Examples of these more sophisticated approaches are provided in Annex E.

Step 5—Treat the Risk

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

What Is It? Risk control action plans are those actions taken to implement risk control measures developed following a risk assessment.

What Should It Achieve? Mitigation controls should capture the output of the risk management process and translate into safe operating conditions or procedures. Options to treat the risks may include the following:

- Avoidance: for example, avoiding risks to operations during a maintenance activity, sections of the movement area can be closed to operations.
- Assumption: accepting the likelihood and consequences associated with the risk: for example, when assessing a risk, it may be classified in the acceptance level and no mitigation action is required.
- Control: developing options and alternatives that minimize or eliminate the risk: for example, a ditch in the runway safety area (RSA) is a hazard because it may cause aircraft damage during an overrun. It can be replaced with a drainage pipe to eliminate the hazard.
- Transfer: shifting the risk to another area: for example, under winter weather conditions, operations can be transferred to an alternative runway where snow and ice removal has taken place.

How Do We Address It? Potential risk treatment options should be evaluated in terms of feasibility, costs, and benefits. The option chosen should be the most appropriate and workable. The objective is to reduce the risk to an acceptable level, or as low as reasonably practical.

Reporting System

What Is It? A reporting system is a process that facilitates the generation, collection, storage, and analysis of information related to safety hazards. It is also part of the hazard identification and risk assessment processes and supports the subsequent follow-up action and feedback to the employees.

Reporting systems are also excellent tools to promote safety and develop a positive safety culture within the organization. Airport employees and stakeholders will feel they have a tool that will allow them to help improve safety, particularly when rapid feedback is provided to their reports.

What Should It Achieve? The goal is to have an open and unhindered sharing of information about safety concerns and safety events, leading to the identification of hazards, a better understanding of risk, and allowing for a more proactive approach to safety management.

How Do We Address It? Set up a report collection system that is simple and easily accessible to all personnel. This system should also be available to external customers and contractors. Make an effort to keep the identity of the reporting individual confidential. Be diligent in providing timely and adequate feedback. Section 6.4 provides an example of a safety reporting template. Legal counsel is appropriate when establishing a reporting system that is intended to be confidential and/or non-punitive because the system needs to be compliant with applicable law.

Internal Safety Investigations

What Is It? An internal safety investigation involves the study and analysis of a safety-significant event that has occurred. Normally, it is applied following an incident or accident, although it could also be triggered by the identification of a significant hazard.

Let's say the auto-level system of a passenger bridge has been reported as inexplicably lowering by itself, even though it has never happened when an aircraft was parked. This certainly would qualify as a hazard worthy of investigation. Therefore, an investigation would be initiated at that point, instead of waiting for a report of an incident or accident caused by the auto-level system when passengers are boarding the aircraft.

What Should It Achieve? The goal is to have a systematic, open, and constructive process for analyzing events, with the intent of improving overall safety by tackling the root causes of accidents.

How Do We Address It? Develop a process to conduct these investigations. Make sure that it clearly identifies the triggers (what or why an investigation will be started), how long after a report or event the investigation should be initiated, who the lead investigator will be, who will participate as part of the analysis and assessment team, and other such issues.

The investigation should focus on finding root causes, and not on finding the "guilty person." Make sure that something is done with the lessons learned, that this leads to further actions when appropriate, and that this information is available to all appropriate staff.

Improving Operating Procedures

What Is It? Operating procedures are a documented way of conducting job-related functions, and a standard practice within most organizations commonly referred to as SOPs. This element of SMS targets those SOPs that directly or indirectly address safety issues and helps to manage safety by ensuring that best practices described in common procedures are modified, as necessary, to reflect safer conditions. This is also a process to control risk.

There is a risk associated with vehicles accessing active runways. To mitigate this risk, most airports require that vehicles entering active runways follow very strict procedures. This would be considered an "operating procedure" within the context of the SMS because it is intended to increase safety.

What Should It Achieve? This element is intended to manage safety by improving the effectiveness and performance of operating procedures and operating practices.

How Do We Address It? Identify all operations and activities associated with the identified risks, review them, and ensure that these practices are still relevant and safe. Revise existing procedures or write new procedures, as appropriate. Make sure to cover all activities and facilities within the organization, and make sure they cover those processes in which contractors are involved.

Assessing the Impact of Changes

What Is It? This mechanism ensures that significant changes are identified, reviewed, analyzed, and put through the risk management process, so that hazards that could be introduced by this change are identified and controlled. A "change" could be anything affecting the operation—a new

procedure, activity, major airfield project that disrupts normal operations, new equipment, or piece of infrastructure, or a change in the organizational structure (a new department, restructuring, or a reassignment of duties, etc.).

What Should It Achieve? The goal is to identify and control hazards associated with any change *before* the change is implemented.

How Do We Address It? Develop a process that (1) clearly identifies the type or magnitude of event (or change) that will trigger a review through the hazard identification process and (2) leads to the development of mitigation controls for the hazards.

A change analysis might not be necessary if one employee in a department of 150 resigns, but you sure might want to consider a review if the Chief Executive Officer retires.

Pillar 3—Safety Assurance

The safety assurance pillar of SMS includes self-auditing, external auditing, and safety oversight. Safety oversight can be achieved through auditing and surveillance practices. Safety assurance aims to ensure that the activities, plans, and actions taken to improve safety are implemented and effective.

One of the core concepts addressed by SMS is continuous improvement. The elements grouped under this pillar provide the tools to accomplish that. This includes ensuring that all measures put in place are adhered to, reviewing and evaluating the actions taken to ensure that they are producing the desired effects, and monitoring business activities and their impact on safety to help determine where your efforts should be directed. Safety Assurance differs from SRM because the target of Safety Assurance is to identify and evaluate deficiencies and improve the performance of the system, instead of looking at individual hazards and associated risks. The focus of Safety Assurance is the effectiveness of the SMS.

Safety Performance Measurement and Monitoring

What Is It? Performance measuring and monitoring is a process to identify and select measurable parameters, collect data related to them, and track and compare this information over time. Safety performance is measured by the trend of a safety performance indicator (SPI) over time.

What Should It Achieve? Performance monitoring and measurement will help you determine whether what you are doing to improve safety in the organization is working and to what extent these efforts are successful. The overall goal is to measure the safety health of the organization so that weaknesses can be identified and dealt with before accidents happen.

How Do We Address It? The first step in the process is to select the appropriate parameters or performance indicators. These parameters normally are derived from the safety goals and objectives set by the organization, but they can also be related to areas that by collective experience are known to be a weak point. Once the appropriate parameters have been selected, you need to identify and collect the data that will allow you to analyze and identify trends.

Section 6.7 contains additional information on how to conduct basic trend analysis.

Internal SMS Assessment

What Is It? This is an internal inspection or assessment of the activities, systems, and processes used by the organization related to safety and the SMS. Most organizations express these internal assessments as "internal audits."

What Should It Achieve? The goal is to have an open and transparent "second look" at the airport activities and the SMS to identify areas where improvements may be needed. It evaluates how effectively the system is working and how safely the operations are being performed by specific airport units, sections, or departments.

How Do We Address It? Set up a process to carry out internal, periodic assessments, audits, and inspections. This process is very similar to the gap analysis prior to SMS implementation, with the difference that an assessment should check the overall performance of the system and identify areas for improvement.

Provide training on how to carry out an assessment and delegate this responsibility to a person in an independent position but with experience with SMS and airport safety; in this way, you will minimize conflict of interest issues. In most cases, assigning the SMS Manager to perform the assessment is not a good idea because it would be putting that person in the position of evaluating his or her own activities. Despite being an internal effort, these assessments are more effective when conducted by an external party (e.g., staff from another airport or a consultant) to provide a fresh, independent, and unbiased look from the outside.

Keep an inquiring mind. For example, if your assessment reveals that the reported hazards are going down in number, do not assume that the hazards facing the organization are going down. The reason might be that, due to lack of adequate feedback, employees have been discouraged from continuing the reporting process or that the volume of operations is decreasing

Self-assessment should be planned to cover the entire workplace. In a small airport, this likely will take several hours, while for a larger airport the assessment could be conducted in different areas of the workplace on different days, or different times throughout a year.

In a small airport, the assessment could be included as part of an annual management meeting. This may take the form of a review of the activities of the previous year to highlight both positive and negative aspects of the airport's safety performance.

Section 6.6 contains detailed information on the process for SMS assessment and Annex A provides SMS assessment checklist tables with a scoring methodology to rate each element.

Management Review

What Is It? Management review is the periodic assessment of how the organization is performing in comparison with the policy and objectives. It is carried out by those who set up the organization safety policy and objectives.

What Should It Achieve? Based on the internal SMS assessment and performance monitoring, the airport management should establish revised safety objectives and actions for making the system better: more efficient, effective, and safer.

How Do We Address It? Establish regular, periodic, and planned management review of SMS. The SMS Manager should ensure that adequate information is provided for the management review and that a strategic plan for safety improvement is generated as a result of this review. During the review process, the line managers, not the SMS Manager, should present their results. The SMS Manager should help these managers with their safety programs; however, the individual responsible for the section presents the safety results for his or her unit.

Pillar 4—Safety Promotion

SMS is most effective when it takes hold in an organization with a positive safety culture. The elements related to safety promotion are intended to support efforts in developing and maintaining a strong safety culture. They will also provide you with tools to ensure that safety information and understanding is transferred throughout the organization, and that everyone is made aware of the hazards and risks associated with particular areas of operation. Section 6.2 provides a more in-depth review on safety culture and how to promote it.

Training and Education

What Is It? The training program ensures personnel are given the appropriate knowledge in SMS processes, and that they have the necessary skills and knowledge to perform their duties competently and safely.

What Should It Achieve? The goal is that all staff members have the appropriate level of training to do their jobs safely. This is not limited to SMS training but does include it. The scope of this element addresses specialized training for all personnel involved in safety-critical activities, and all personnel, in general, for SMS. Generally speaking, training should be an on-going, recurring activity, and not just a one-time thing.

How Do We Address It? Start by ensuring that training needs at all levels are defined (i.e., identify who needs to know what) and that resources are identified to meet training needs. Ensure that basic SMS training is provided to all personnel, including subcontractors.

A common mistake is to deliver the same training course to the whole organization. This approach will likely mean that training will be too specific for those in need of only an orientation session and too generic for those responsible for carrying out core SMS duties. Make sure that you tailor your courses to the appropriate level.

A training program might be as simple as taking time, once every few months, to read up on some aspect of safety management, such as the experiences of another company in making SMS work well. A larger airport will require organized briefings to personnel. In all cases, because training is an essential element of SMS, it should be documented.

Section 6.8 provides information on safety training needs for airport workers and contains suggested training programs for different levels of airport and non-airport staff.

Safety Communication

What Is It? As part of the SMS, there should be a process in place to formalize information sharing across all levels of the organization and between the organization and external agencies to ensure that staff members have the adequate safety information they need.

What Should It Achieve? The goal is to promote a positive safety culture through the free exchange of safety information to ensure that the organization functions as a single entity when it comes to safety and to eliminate the emergence of silos (isolated groups) on safety issues by sharing lessons learned.

How Do We Address It? Develop formal means of two-way communication between all stakeholders including management and staff, staff and staff, and organization and organization. Ensure that there is a way to communicate with outside stakeholders—tenants, contractors, and other groups—to share mistakes, lessons learned, and best practices.

Make sure that employees are involved or consulted in the development and review of policies and procedures implemented to manage risks (because they know their area of operation better than anyone else).

Some of the best vehicles to ensure an efficient communication process are through the implementation of non-punitive reporting systems, cascading meetings (see Section 6.3), safety committees, and bulletin boards. For example, create multi-disciplinary, multi-level safety committees, or operational committees, for which safety is a standing agenda item, and where SMS-related issues are assessed critically and discussed objectively.

In very small airports, where the planners and the doers are the same people or are working closely together, the main method of communication probably will be verbal. In this case, the verification that actions are in fact implemented, and that feedback is obtained, occurs on a daily basis. If this is your case, you should state that in your SMS documentation to show that you actively thought about it. Documenting communications will also help keep track of processes when something goes wrong or when employees leave the organization.

Make sure that safety information is disseminated throughout the organization. The effectiveness of this process should be measured during SMS assessments (see Section 6.6).

Continuous Improvement

What Is It? Continuous improvement is more than a process. It is an attitude. It becomes tangible in the actions that we take following every inspection, audit, assessment, review, and management review.

What Should It Achieve? It serves to define on-going work for making the system more efficient, effective, and safer.

How Do We Address It? Continuous improvement is achieved through regular, periodic, and planned reviews, which are conducted regarding the airport's safety processes and performance. The SMS Manager may solicit input through the non-punitive safety reporting system.

An organization's management provides the foundation for continuous improvement of an effective SMS.

Major decisions and actions aimed at improving safety are monitored to evaluate their effectiveness. Further action is taken when the expected risk benefit is not achieved or when there is room for improvement.

Now that we have described each element and process one-by-one, the following section illustrates the relationships between all of the SMS elements and processes.

2.3 Example of an Airport SMS in Practice

At XYZ Airport, the Chief Executive Officer (CEO) is fully aware of and embraces her role as the Accountable Executive in the context of SMS. There is a sign on her door that reads, "When it comes to safety, the buck stops here."

This Accountable Executive started by making a public commitment to SMS with a **safety policy.** This policy statement, which was developed in conjunction with the senior management team, clearly describes XYZ's commitment to safety. Everybody knows the Accountable Executive is behind the policy because her signature is prominently displayed at the bottom.

Everyone at XYZ knows about the policy because it is discussed periodically at meetings and safety talks, both of which are part of a comprehensive **safety communications** plan, and also because it can be seen on display boards in key areas of the airport right next to the **safety objectives** of the organization.

Similar displays can be found in prominent areas in every department. These boards include an organizational chart and pictures of **key safety personnel,** including their names, contact numbers, and e-mail addresses. The key safety personnel displayed are the SMS Manager, the department managers and supervisors, and the airport CEO. All employees are fully aware of "who is who" and where they fit within the organization. XYZ staff members know who to talk to when they have a safety concern and when to **report a safety hazard** through the blank safety report forms and drop boxes adjacent to the display boards.

Employees use the safety report forms with confidence because, since they first came into use, a series of safety improvements has occurred. In all cases, the reporter received prompt **feedback** about the concern from either the SMS Manager or the reporter's supervisor. Employees know that feedback is guaranteed, even when they do not want to be identified. In the case of an anonymous report, feedback is posted on the same display.

Most anonymous reports are from XYZ tenant employees who work for companies that, unlike XYZ, do not offer a **non-punitive reporting policy.** The anonymous option, paired with the ability to fill in an electronic report form on either the airport intranet or external website, ensures that all possible hazardous situations are reported to the airport, regardless of origin.

All XYZ employees are well aware that they are a critical link in the **hazard identification** process in place at the airport. This information is displayed boldly in the employee handbooks they received when they were first hired and is discussed as part of weekly safety talks that are held with their department supervisor. Further awareness comes from the specific training

program that each employee is part of, specifically in the form of **indoctrination training** and continual refresher and recurrent training based on job needs analyses.

All this **training** and preparation assures supervisors and department managers that they can count on competent staff to perform their duties, but it also provides them with the support they need to perform SMS-specific duties. That is why supervisors and managers include their staff in the development of SOP and brainstorming sessions to identify new hazards (especially when they are due to a **significant change** occurring in the airport). After all, they are the ones out there doing the work—they know best!

Through training and participation, employees are fully aware that all hazardous situations or events need to be reported, and that when submitted, the SMS Manager will review them and make sure that they are assessed appropriately. However, some personnel are not familiar with the process that follows.

Following a report, the SMS Manager will identify the risks associated with each hazard reported. This is done using a risk matrix that helps **assess the level of severity and probability of the risk and prioritize** this risk for taking appropriate actions. The SMS Manager makes good use of such risk assessments; although the airport has only limited resources, she is able to allocate appropriately because she knows where the major safety concerns are. Moreover, by establishing proper **corrective or mitigating actions,** the SMS Manager is able to estimate how much it will cost to maintain a safe airport environment.

XYZ staff members are aware that, once they make a report, the SMS Manager will usually contact them to obtain more information. Working with the department supervisor, the SMS Manager will **investigate** the hazard and determine the root cause of the problem. Sometimes employees complain about how many "whys" they have to answer, but in the end they do not mind because they know that these questions will result in **actions to correct** the problem. These actions usually take the form of a new procedure or a change to infrastructure or training. XYZ staff are also confident that blame normally is not laid, unless someone was under the influence of alcohol or other drugs, or negligent during his/her actions.

All this hard work makes the SMS Manager a popular person at the airport. The SMS Manager can be spotted walking around the facilities, sometimes accompanied by the CEO. The SMS Manager talks to people, always listens to any concerns, and has good tips on safety issues.

However, most employees are not aware of what the SMS Manager is doing when she is not walking around. Staff are not aware that when the SMS Manager is not with department managers and supervisors, supporting them by providing material for their weekly safety talks or facilitating a brainstorming session to identify hazards, she probably is developing a new safety activity, for example, planning an event for the **safety education** campaign, writing a new safety bulletin, or **gathering and analyzing data** to see if she can **identify any trends.**

The SMS Manager is an important help to the CEO. She gathers all the safety-related data and reports from line managers and summarizes this information for the CEO when asked for a status update or when it comes time for the **management review.**

The management review is a key function that ensures that the XYZ SMS is working properly and that noticeable improvements in safety performance are seen at the airport. At least once a year, this important meeting takes place where senior management and the SMS Manager get together with the CEO to review and assess SMS performance. The meeting starts with the review of the safety objectives set up at the beginning of the year. The CEO will ask all department managers to talk about how their internal objectives compare with their end-of-year results. Of course, there are few surprises here because **self-inspections and audits** throughout the year allow management to keep a close eye on how things are going. Nonetheless, this management review is an exercise that will support the adjustment and development of the safety objectives for the next year.

You might wonder, in a hectic environment such as an airport, how people remember what happened during the year. The answer is corporate memory. XYZ understands that corporate memory can be preserved only by documenting what happened, why it happened, and what was done about it.

To make sure that actions, decisions, and events are not lost or forgotten, XYZ has developed a **document management** system that ensures all important information is **registered and recorded.**

XYZ also takes advantage of this system to make sure that they are always up to date with new **regulations and legislation.** This helps the airport comply with all the latest legal and regulatory requirements and is especially useful when a safety inspection is coming.

Another benefit of this document control system is that **obsolete documents** are very difficult to find and hardly ever used. Things such as work instructions and SOP are kept current. This is good for employees because they know that when they use a document or procedure, it is the latest approved version. The document control system also ensures that any time a corrective action requires a new procedure or a modification to an existing one, it is updated and the training needs are reviewed.

Training is reviewed on a continual basis, not only when changes are necessary. Normally, the department manager and the training coordinator (if available) will review training needs according to the schedule established in the **training program.** This review ensures that the skills necessary to perform each job safely and effectively are provided to each employee before the employee starts doing the work. That is why training development normally starts with a **job analysis** to identify the tasks associated with each job function. These tasks are then included in each job description, and an assessment is performed at a later date to make sure that the training that was given is appropriate.

XYZ is confident that, while accidents are sometimes inevitable, the processes set up, adopted, and included in their **SMS documentation** are supporting their ultimate goal of **continuous improvement** on safety. Moreover, they are experiencing collateral benefits such as an increase in employee morale and financial performance.

2.4 Objectives of SMS

An SMS has two main purposes. The first is to reduce the safety risks for passengers, aircraft, personnel, and property to a level as low as reasonably practical (ALARP). The second is to assist managers with their constant challenge of balancing costs, volume of operations and safety. With SMS, hazards are identified and analyzed to bring about safety priorities and estimated costs for those actions that are needed to control the risks. Risks are rated and when found unacceptable it is time to balance the volume of operations with the level of safety. It is wiser to interrupt operations and clean up a movement area with foreign object debris (FOD) than continue operations under those circumstances.

There is construction debris on the runway shoulders. Should we stop operations and clean up the area or just keep going until we get an opportunity later on?

An SMS provides objective information that helps airports identify and prioritize safety needs, as well as choose cost-effective strategies to improve the safety of their activities. In safety management, one size does not fit all. Airports should tailor the implementation process to consider their individual needs, priorities, goals, and level of resources.

The SMS can be thought of as a tool or series of tools to assist in the management decision-making process. Its purpose is to provide consistent and accurate information based on actual

conditions. It is the link between the airport management and the world of safety data available to support their decisions. If you can classify the risks that you have identified, you will be able to determine which ones should be treated first. Moreover, you will find when and how to take the actions to mitigate these risks.

The main objectives for an effective SMS effort include ensuring the following:

- Management is always aware of the risks associated with the airport activities and formally documents this awareness
- Personnel identify, assess, track, and monitor hazards associated with the airport activities and either eliminate or control the associated risks to an acceptable level throughout the life cycle
- Personnel identify and archive actions taken to eliminate or reduce risk for the purpose of tracking and learning safety lessons
- Personnel consider and use historical hazard data, including lessons learned from other organizations, particularly airports
- Personnel quantify and minimize risks resulting from human error in operating, maintaining, and supporting airport activities
- Personnel evaluate and minimize risks resulting from hazardous conditions
- Airport management keeps airport stakeholders abreast of the safety considerations and includes them in the safety decision process

2.5 Origins of SMS

The SMS concept grew out of the Plan-Do-Check-Act (PDCA) cycle, also known as the Deming cycle of continuous improvement. The concept depicted in Figure 2 was originally employed in quality management and forms the basis of the current international quality standard ISO 9001.

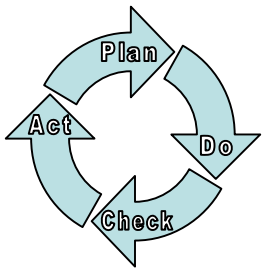


Figure 2. The PDCA cycle.

When properly implemented, a safety management system provides the airport personnel with a systematic way to continuously monitor and improve processes and behaviors that affect both safety and operational effectiveness at the airport. It is constantly working and requires the engagement of all airport employees. Here are some examples of typical airport SMS actions that fit into the PDCA process.

Plan. Your SMS helps you to plan activities. These plans then guide systematic methods of performing activities. Plans might include documented policies, objectives, SOPs, self-inspections, schedules, employee training programs, checklists, and so forth.

Do. The people in your airport should then perform tasks in accordance with those plans. After all, the plans represent what you believe to be the best way to carry out the tasks in a safe manner. This does not always happen automatically; it is likely that increased leadership commitment and training will be required to ensure acceptance of the system and adherence to planned methods.

Check. There is a need to check whether everything is going according to the plans, and there are numerous mechanisms to do that. On a day-to-day basis, everyone in the airport should be given the opportunity to report hazards, accidents, and near misses, and to suggest improvements. When implemented correctly, this can be a very useful aspect of an SMS.

On a more formal basis, the system should be checked regularly to ensure that your practice matches your expectations or plans. These regular checks are done by monitoring safety performance results, internal audits, and regular management reviews. These words may sound ominous to some, but they can be very straightforward and positive activities. In some instances, they may be supplemented by external audits from the FAA.

Act. Take action when something is wrong or could be done better. This may be a corrective, preventive, or improvement action. Of course, in most cases, action to "put things right" will also occur in airports that do not have a formal SMS. However, in some cases, the same problems occur time and again because there is no mechanism to assess risks, record, prioritize, and deal with them. This is one of the great benefits of an SMS.

Whether you use paper forms, spreadsheets, or software applications, every SMS must have a means to identify hazards, assess risks, develop possible improvements, plan actions, and monitor hazards and mitigation actions.

The actions that are taken may vary from case to case. They may include removing an obstacle, cleaning debris, providing training to employees, improving an SOP, purchasing new equipment, or making other remediation.

2.6 How Does an SMS Accomplish Key Objectives?

An SMS structure with the essential elements is integrated in the airport organization. The safety policy statement, organizational structure, and safety objectives provide the overall SMS framework. That framework is promoted to staff via training and education, safety communication, and the fostering of an attitude of continuous improvement.

Risk is then managed through the hazard identification, accident investigation, risk assessment, mitigation actions, and risk monitoring processes. Safety is ensured with trend analysis, auditing, and management review. Ultimately, through the implementation of an effective SMS, safety is woven into the fabric of the organization and becomes part of the airport's culture and the way people do their jobs.

The heart of an SMS is the SRM process. A safety concern, problem, hazard, or occurrence is identified and reported (what's wrong?). It is then analyzed (how can we fix it?) and a mitigation measure is implemented, followed by an evaluation of its effectiveness (did it work?). If the problem is resolved, then it is documented. If it is not resolved, it must be re-analyzed, possibly resulting in a different mitigation measure followed by another evaluation.

2.7 Do I Need an SMS?

Most airports need an SMS, and not only to comply with possible future FAA regulations. To determine whether your airport needs an SMS, consider the following questions:

Have you or your staff ever had an accident that could have been prevented with a little more foresight?

Do you feel that you would like to be committed to airport safety, but do not know where to start?

Has there been an accident at your workplace and you found out later that most of the staff could actually see it coming but did not say anything?

Have safety issues been reported, but you could not effectively address the issues because you had no system for evaluating how serious they were, or even recording them?

Have you ever had a sudden increase in accidents and not known why they happened or when they will end?

Have you ever set down an SOP for the airport that was soon forgotten or ignored?

Are you happy with your safety performance, but finding the safety performance of your tenants and contractors lets you down, or even puts your airport activities at risk?

Are there people in your airport who do not know their responsibilities with regard to safety?

When a key safety person in your airport is away, is his/her substitute ever unsure what to do?

Have you ever had an emergency that was not well managed?

Do airport workers only comply with safety rules when compelled?

Is safety management disorganized and confusing in your airport?

If you responded yes to any of these questions, an SMS can help you reduce or eliminate these problems. It is not something miraculous—simply good business practice. Here are some general reasons for having an SMS:

- SMS is not new. Other major industries have implemented SMS for decades, and to revert to the "old days without SMS" is simply unthinkable for them. They have already gained so much.
- From a purely business point of view, there's no reason to wait to improve effectiveness and reduce safety risks. Implementing an SMS has a cost, but the cost is definitely less than smashing an aircraft with a tug.
- SMS will be an ICAO standard beginning November 2010, and the FAA[(1),(13),(14)] is gradually moving to require it, too. SMS should be on your agenda because a well-planned, carefully monitored, evenly distributed effort is preferable to a last-minute rush.
- SMS is not an experimental project. The guidelines and the experience to develop an effective airport SMS are available to you.
- An SMS helps minimize injuries and property losses, as well as keep your airport's costs down.

2.8 What Will I Get Out of It?

It is impossible to deny there are some expenses (and some risks) in implementing an SMS; however, these are more than offset by the good that comes from an SMS. There are many claims made about the benefits of SMS:

- Reduced likelihood of accidents
- Reduced costs relating to accidents and incidents
- Assurance that a systematic process to monitor and address safety issues in a transparent and informed way is in place
- The potential for reduced insurance and liability costs
- Competitive advantage and possibility of more business opportunities
- Improved regulatory compliance

- Improved employee morale and performance
- Identification of the best use of limited resources available
- Reduced reliance on a few key personnel
- Improved control
- Consistency
- Improved productivity

These claims and more can make quite an impressive list for the benefits of an SMS.

- Are they achievable? ⇨ Yes
- Are they guaranteed? ⇨ No

Significant benefits certainly are achievable, but they will require some effort and discipline.

Even a fully implemented SMS does not guarantee an accident-free airport; no management system can hope for that level of effectiveness. To be realistic, an SMS is simply an integrated collection of effective management actions that can lead to a safer airport and aviation system.

CHAPTER 3

Getting Started

A system is defined as a set of interacting or interdependent entities, real or abstract, forming an integrated whole. An SMS has several functions or parts that need to work well together to be effective in helping maintain the airport as a safe place.

Implementing an SMS involves following a small number of basic principles and then adapting proven SMS pillars to fit the size, type, and management style of the operation. As you read this document, you will likely find that most of the pillars and elements for SMS are already present in your airport.

To have an SMS, the airport operator needs to put in place the elements or functions required by an SMS. For example, one of the required SMS elements is a safety reporting process. The airport should make available one or more means to allow airport workers (staff and non-staff), and even passengers, to report safety issues and hazards. For example, a phone line that is accessible to anyone using or working at the airport could be an alternative. However, the process involves much more than the phone line. The notification provided needs to be forwarded to the right person, who is responsible for recording, analyzing, and taking specific actions. The reporter also needs to get some feedback on his/her report; otherwise, the reporter may not feel like submitting another report.

The requirements for each SMS process are described in this guidebook. The implementation process and phases are described in Chapter 4. The airport operator needs to follow six basic steps to achieve the goal of implementing the system.

This chapter will help you take the initial steps toward SMS implementation at your airport. Each section describes one step on the SMS planning phase before the implementation is initiated. These steps include the following:

1. Obtaining support from management to develop the SMS (Section 3.1)
2. Finding the right project manager to coordinate the SMS planning activities (Section 3.2)
3. Selecting an appropriate SMS structure or model (Section 3.3)
4. Determining how to use the resources and SMS processes that the airport already has and build upon them (Section 3.4)
5. Conducting a gap analysis to determine which SMS elements the airport already has, which ones need to be adapted, and which ones need to be created (Section 3.5)
6. Documenting the SMS (Section 3.6)

3.1 Management Commitment

Safety, it is often said, is everybody's business. Every member of an organization has a role to play in the management of safety. However, for SMS to be anything other than a collection of

papers, it needs true support from management. Management support from the very beginning will be extremely important. It starts with a strong safety policy statement and a commitment to its elements. Management will then, among other things, allocate sufficient resources for the development and implementation of the SMS, and facilitate the flow of information (between departments, by authorizing meetings, posters, etc).

Some of the resources necessary to start the process are an "SMS Champion" (to coordinate the process), time (for meetings, information gathering, planning, and communications), and expertise (consultants and specialists as required).

3.2 Appoint an SMS Champion

The SMS Champion will coordinate and oversee SMS through planning, development, and implementation. Once your SMS is up and running, the job of on-going coordination and administration of the system will be transferred to the SMS Manager.

The SMS Champion's main role is project management for SMS implementation. This individual should have a good understanding of management principles, as well as functional knowledge of operational activities of the airport. It is advantageous for this person to have good communication skills, as well as respect and recognition within the airport organization, since most of the job will be to promote SMS with line personnel and middle management and to obtain resources and support from top management.

Who should lead the SMS implementation effort? In this case, skills and experience are more important than job title. The SMS Champion should have good people skills, a solid understanding of SMS, a track record of earning respect within the airport, and good project management capabilities. You need a Champion who can be both advocate and manager.

Depending on the size of the airport organization, the SMS Champion could be responsible for planning and executing all phases of the implementation alone or with the support of a team. If the support of a team is available, it is desirable that team members represent a cross section of all areas of the organization.

The SMS Champion and the SMS Manager can be the same person or not. The future SMS Manager should be involved with the implementation as early as possible, and it is desirable to have the future SMS Manager responsible for the implementation.

At large airports, the person that will be appointed SMS Manager may not have the project management skills or experience to carry out the implementation and, in this case, it is justifiable to have an SMS Champion or Project Manager for SMS Implementation that is not the future SMS Manager.

3.3 Select an SMS Model Structure

SMS requirements typically are performance-based. This means that though SMS must achieve certain objectives, the manner to achieve them is left to the operator. It is important when selecting an SMS model that it is based on the PDCA cycle and that it allows for external audits. Most published models have the following features:

- FAA AC 150/5200-37—Safety Management Systems (SMS) for Airport Operators: 4 pillars (safety policy and objectives; safety risk management; safety assurance; and safety promotion) and 18 elements
- FAA AC 120-92—Introduction to Safety Management System for Air Operator: 4 pillars
- Occupational Health & Safety Assessment Series (OHSAS) 18001[16]: 17 elements*
- ICAO[3]: 4 pillars and 12 elements
- Transport Canada[17],[18],[19],[20]: 17 elements**
- Civil Aviation Authority of UK[21],[22],[23],[24]: 6 elements**
- Civil Aviation Safety Authority of Australia[10]: 8 elements**

When you choose a model for your SMS, make sure that it covers all of the elements described in this document.

One way to make sure that your model is complete is to create a table of concordance that shows where the SMS elements are within your system.

Using the model depicted in FAA AC 150/5200-37 may facilitate verifying agreement with these recommendations.

3.4 Build on What You Have

An SMS will be most effective if it is built on existing practices and tailored to the airport's size, complexity, type of operation, safety culture, and operating environment. Before designing your SMS, you will try to identify the SMS processes that you already have in place; this is called gap analysis and will be discussed in more detail in Section 3.5. You may be surprised to find how much you already have at your airport. If your airport is certificated under Part 139, many of the safety responsibilities are described in your Certification Manual. Moreover, you already have some proactive hazard identification procedures as part of the required daily self-inspections. In many cases, there are document and records management processes. Some airports even have other comprehensive management systems, such as environmental and wildlife management systems[15] that can be adapted or built on to handle safety issues using similar processes.

Some airports collect safety data and perform trend analysis; however, most airports without SMS have no formal SRM process in place. Currently, most airports do not have a regular or ad hoc plan for safety audits or assessments, and they may need to create the processes and train staff.

Table 1 lists some of the elements that you may already have at your airport and describes how they can be helpful to your SMS.

*OSHA focus is on occupational health and safety; SMS goes beyond these to operational safety, however both use the same principles

**to date, Canada, the United Kingdom, and Australia have not integrated OSHA and SMS

Table 1. Using your existing resources.

Examples of Existing Resources	How to Use It in Your SMS
A phone hotline that people can use to report safety issues to the department of operations.	Small and medium airports can use an existing line for safety reporting. Larger airports may want to install a specific SMS hotline if necessary.
An intranet and/or an Internet website.	Your airport can create an SMS webpage to disseminate safety information and provide a forum where people can report hazards and other safety issues.
An airport newsletter.	You may want to add a specific section on safety to facilitate disseminating safety information at the airport.
Regular meetings with managers and airport stakeholders.	Your SMS documentation may include a requirement to have safety as a mandatory agenda item at some meetings. These meetings are excellent forums for discussions and brainstorming on safety issues, and they provide an excellent source of input to the SMS Manager.
Procedures for daily self-inspections of the airside areas.	Such activities are mandatory for Part 139 airports and are very effective for hazard identification. Extending the self-inspections to the landside and to the terminal, if not yet in place, will create an effective procedure for hazard identification when your SMS scope covers such areas. Introducing processes to pass the safety information from these inspections to the SMS Manager will integrate the self-inspection process to the SMS.
Environmental and/or wildlife management systems.	Most of the processes available for these systems can be adapted and used for your SMS. Much of the existing experience can be transferred to the SMS team.
Some of the airlines operating at your airport may have some SMS elements in place. At airports sharing civilian and military operations, it is possible that the military organization has an SMS in place.	In general, other organizations are willing to share their experience and, in some cases, even their tools. The airport SMS team has much to learn and gain from other organizations' experience with SMS processes.
Procedures for accident/incident investigations. If your airport has a risk management section, the staff may have a good starting point for safety investigation procedures and perhaps qualified people to provide training. Public safety and enforcement officers also have specific procedures and experience conducting accident investigations.	In most cases, public safety investigations obtain information on how the accident occurred rather than on the root causes when determining why an accident happened. The existing investigation procedures can be adapted and staff trained to search for root causes of accidents and incidents.
Part 139 requires airports to keep records of training, fueling agent inspections, self-inspections, accidents, and incidents.	SMS also recommends keeping such records. They can be very helpful for accident and incident investigations. Part 139 records may be an excellent source of data for developing trend analysis.
Control of documents and records.	Many airports, particularly medium and large hubs have approved procedures for document and records control. These procedures are also applicable to SMS.

Table 1. (Continued).

Examples of Existing Resources	How to Use It in Your SMS
Safety committees.	Many airports have safety committees to coordinate operations, ramp activities, runway incursion, and FOD programs, etc. The same committees can be part of your SMS organizational structure.
Safety management for Part 139 requirements (training, condition of movement areas, wildlife control, emergency response, plan for snow and ice control, reporting airport conditions, handling and storage of hazardous substances and materials, access and traffic control of movement and safety areas, control of obstructions and protection of navigational aids (NAVAIDs), public safety, identification of construction and unserviceable areas)	Each of these requirements should be addressed from both Part 139 compliance and SMS standpoints. SMS may help improve these processes using its systematic and proactive approach; however, when compliance and SMS priorities are not in agreement, even when risks are considered under control, compliance should be achieved for continuity of operations.
Operational responsibilities of key staff defined in the Airport Certification Manual (ACM).	The organizational structure and safety responsibilities described in the SMS Manual should be compatible and built on this structure. It will be necessary to include a safety management function that covers all areas within the SMS scope (airside, landside, terminal) for the airport.
Existing safety objectives.	Some airports, particularly large hubs, have a few safety objectives that are measured and monitored (e.g., reducing the number of ramp accidents by 15%). These same objectives can be maintained and even supported by departmental goals.
Existing rules, regulations, and SOP.	Many of the actions identified in the SRM for controlling risks will involve the enforcement or improvement of existing procedures.
Trend analysis.	Some airports, particularly large and medium hubs, regularly collect data on accidents at the ramp and keep monitoring trends. Certificated airports keep track of their runway incursions and identify “hot spots.” Wildlife management programs keep track of trends for wildlife hazards.
An audit function (most likely available at larger airports).	The audit unit may be able to carry out SMS and safety assessments. In this case, the assessment team should have members that are knowledgeable of the area being assessed. If this is not the case, the audit unit may have audit procedures and be able to train airport staff in conducting general assessments that can be adapted to verify safety.
Part 139 airports comply with OSHA regulations and may have the associated management processes.	Many of the existing OSHA management processes can be adapted and used for your SMS. Much of the existing experience can be transferred to the SMS team.

3.5 Conduct a Gap Analysis

Once you have selected the SMS model appropriate for your airport, you are ready to move forward and find out how your organization measures up against SMS best practices. To do this you will need to conduct a gap analysis. This task is performed before you write your SMS documentation and implementation plan. It is intended to identify the processes already existing in your airport, compare what you have against the requirements established by the pillars and elements of the SMS model that you have chosen, and identify what should be done to make these two pictures match.

It may be beneficial to get an independent person/group to help you conduct the gap analysis. This will ensure that you get an objective look at the strengths and weaknesses of your existing processes. Hiring a private consultant is not the only way of doing this; you could also make an agreement with another similar organization in your region to conduct each other's gap analyses.

The Gap Analysis Process

The gap analysis will include both a document review and interactions with airport staff from all levels. The document review will focus on existing operations, organization documentation, and current procedures. The interactions—in the form of interviews, meetings, and discussions—will reach personnel at every level (senior management, middle management, and hourly employees) of all relevant departments of the airport including the following:

- Operations
- Emergency Response (i.e., Aircraft Rescue and Fire Fighting [ARFF])
- Public Safety and Security
- Maintenance
- Engineering, Planning, and Development
- Offices of Existing Management Systems (e.g., risk, environmental, wildlife)
- Marketing and Business Development
- Human Resources
- Finance and Legal Affairs
- Airlines
- Fixed Base Operators (FBO) and Service Providers

Depending on time availability and the information gathered during the document review and personnel interviews, follow-up meetings and meetings with external parties may be required.

The gap analysis process is a great opportunity, not only to find what is missing, but also to identify key airport staff for the SMS and how to fill the gaps identified.

The gap analysis should not include

- Assessment of facilities or processes within the airport that are not directly related to the scope of the SMS. For example, if the airport decides to start with the implementation for the airside only, then only those processes associated with safety in the airside area will be relevant.

- For most airports, the initial scope of SMS will be restricted to the activities for which the airport operator is responsible. Assessment of safety practices of tenants or organizations other than the airport organization may not be warranted.
- Assessment of any other applicable health and safety requirements (i.e., OSHA requirements), such as those that might be required by state or federal regulations.

It is desirable to have the airport designate a team of airport staff from different professional backgrounds to participate in selected meetings and discussions. Should this not be feasible, the SMS Champion should be the liaison between the parties and should facilitate team access to documentation and individuals.

The gap analysis process needs to be well planned and executed. You need to have a checklist to remind you what to look for and to organize your notes. You will review the airport documents associated with organization and safety, and you will interview airport staff and stakeholders to assess how they take care of the airport's safety, procedures they use, and coordination with other parties.

Gap Analysis Tables

You will need a checklist to make sure you cover all relevant SMS elements and to facilitate your annotations. You can use the SMS gap analysis and SMS assessment tables provided in Annex A; these tables are based on a general SMS model and were adapted using the SMS structure described in FAA AC 150/5200-37.

The tables are organized by SMS pillar and element. Each page provides space for the user to describe the specific airport reference where the information was identified, a space to assign a subjective level of conformity, and space to write notes. It is important to note that you need to evaluate the conformity for each sub-element before assessing the element as a whole. The same is true for the assessment of SMS pillars; you first need to evaluate each element before judging the main pillars.

The documents in use by your airport may not have the same names described in these tables, or your airport may have documents that are applicable to more than one sub-element or element.

Once the answers for a particular area are determined, you should rate the sub-elements, elements, and SMS pillars, as described in Table 2.

Obtaining Relevant Information

The main sources of information to complete these tables are the airport documents (e.g., ACM, rules and regulations) and the interviews that you will conduct with airport staff and stakeholders.

Review of Airport Documents

Before moving ahead with interviews, the gap analysis team should be familiar with the airport and its documentation. The most common documents that should be analyzed are the following:

- Airport Certification Manual
- Airport Emergency Plan
- Rules and regulations
- Policies and procedures
- Training records
- Airport organizational chart

Table 2. Rating your SMS elements.

Rate Shading	Rate	Rate Description	Comment
	Not applicable (N/A)	The sub-element may not be applicable because the SMS is not in place yet. The same tables can be used for SMS assessment after the SMS has been implemented.	For example, consolidated documentation that describes the SMS and the interrelationships between all its pillars is N/A.
	Meets expectations	Fulfills SMS needs, even if some minor work is necessary to incorporate it into the SMS.	For example, license and permit requirements generally are in place, and legal requirements implemented for Part 139 airports.
	Needs improvement	The concept is present but missing something. Some work will be required to incorporate it into the SMS.	A safety policy may be in place, but if it lacks safety objectives, it should be rated in this level.
	Not in place	The sub-element is missing and needs to be developed and implemented.	Some airports do not have an SRM process in place.

- Construction safety plans
- Self-inspection reports
- Accident investigation procedures (if available)
- Minutes of safety meetings

Other documents may be identified as relevant during the interview process and added to the list.

Interviews

Some airports prefer to submit the gap analysis tables as questionnaires to obtain written responses from staff and stakeholders. In general, this methodology is not very effective because the questionnaire may be too long, airport workers may not be familiar with SMS, and many of the elements are not related to their work activities. Also, the questionnaire will restrict important interactions between the interviewer and the interviewees.

Interviews are preferred, and the interviewer should avoid going through each and every line of the tables. Before initiating the interview, the interviewer should explain the purpose and answer any questions the respondent may have about the interview. It is essential to point out to the interviewee that it is not an audit and to explain briefly what SMS is. The interviewer should make notes on the checklist, and these notes should be consolidated as soon as possible to avoid losing the information, particularly the interpretation of responses in regards to SMS.

Gap Analysis Report

Once the checklist is complete, the gap analysis team will generate the main conclusions. A report should be prepared to document the process and findings. The gap analysis report documents the findings of the gap analysis. It provides a summary of what is missing within the airport processes and organization in regards to a formalized and structured SMS. This document provides

Table 3. Contents of a gap analysis report.

Item	Report Section	Content
1	Executive Summary	The gap analysis purpose and a summary of the process and main conclusions
2	Introduction	Gap analysis date and team
2.1	Goal	General objective of the process
2.2	Scope	Specific scope of the gap analysis associated with the SMS scope (e.g., whole airport, airside)
2.3	Gap Analysis Process	How the information for the gap analysis was gathered and the source of the checklist used
3	Analysis	Summary of the main gaps relative to the selected SMS model
A	Annex A. Gap Analysis Tables	Assessment tables consolidating the information gathered and analyzed during the gap analysis
B	Annex B. Gap Analysis Data Sources	Major sources of data
B.1	Gap Analysis Interviews	List of personnel interviewed, including their position and department
B.2	Documents Reviewed	List of airport documents reviewed
B.3	Other Activities	Other activities associated with the gap analysis, including visit to the airport facilities, demonstration of existing software, etc.

an important summary to assist airport management and is used to define the roadmap to SMS implementation.

A typical gap report may contain the sections indicated in Table 3.

Table 4 depicts an example of a populated gap analysis table.

3.6 Documenting Your SMS

The SMS documentation is made up of the airport SMS Manual and the specific procedures for the SMS processes. Figure 3 depicts the different levels of documentation. Overall, the SMS documentation should provide a description on how the SMS will be or has been set up, who is responsible for what, which processes and procedures are going to be used and when. Because SMS is not a regulatory requirement in the United States at this time, the SMS Manual should remain separate from the ACM required under 14 CFR Part 139.

The SMS Manual describes the SMS elements and how they will be established and will function. It is a document that may resemble the ACM. Whereas the ACM describes how the airport operates, the SMS manual describes how the SMS functions. Unless the FAA makes changes to Part 139, your SMS Manual should not be part of your ACM; for the time being, these two manuals should be separate documents.

The SMS documentation should ensure that the information within the references (e.g., operating manuals) is consistent with the top-level SMS document. All SMS documents need to be controlled, coordinated, cross-referenced, and managed.

The SMS Manual can be used as the primary document to identify the key processes that are part of the management system. Where necessary, it should refer to other appropriate documentation, such as the ACM.

Table 4. Example of a gap analysis table.

1. SAFETY RISK MANAGEMENT			
Expectations (specific expectation or best practice)	**Organization Reference**	**Eval.**	**Remarks**
1.1 Hazard identification			*Reactive hazard identification mechanisms are in place. Recording and analysis of hazards could be more comprehensive. Feedback and sharing of lessons learned is not systematic.*
1.1.1 Hazard identification process			
1.1.1.1 A procedure for the identification of hazards and assessment of risks is established and the methodology is defined.	*Daily self-inspection reports, maintenance reports*		*There are proactive mechanisms to identify and report hazards, such as daily self-inspections, a Part 139 requirement. However, these inspections are aimed only at the airside and limited to staff trained for such inspection.*
▪ **Reporting systems**			
1.1.1.2 There is a reporting process, which is simple and accessible.	*Computer-Aided Dispatch (CAD) records, incident reports*		*Yes. Radio and telephone calls to dispatch.*
1.1.1.3 Reports are reviewed at the appropriate level of management.			*Yes.*
1.1.1.4 There is a feedback process to notify contributors that their reports have been received and to share the results of the analysis.			*Not found.*
1.1.1.5 All identified hazard data are systematically recorded, stored, and analyzed.			*Not consistently. If there is an associated incident number or case number the event is recorded in the CAD system; some hazards are recorded through work orders; otherwise, the information is passed on directly to the appropriate person and not recorded by dispatch.*
1.1.1.6 There is a system to share significant safety event information with other similar organizations, subject to reasonable restriction on proprietary and confidential information.			*Not found, other than casual interactions through conferences and industry events.*

Meets expectations
Needs improvement
Not in place

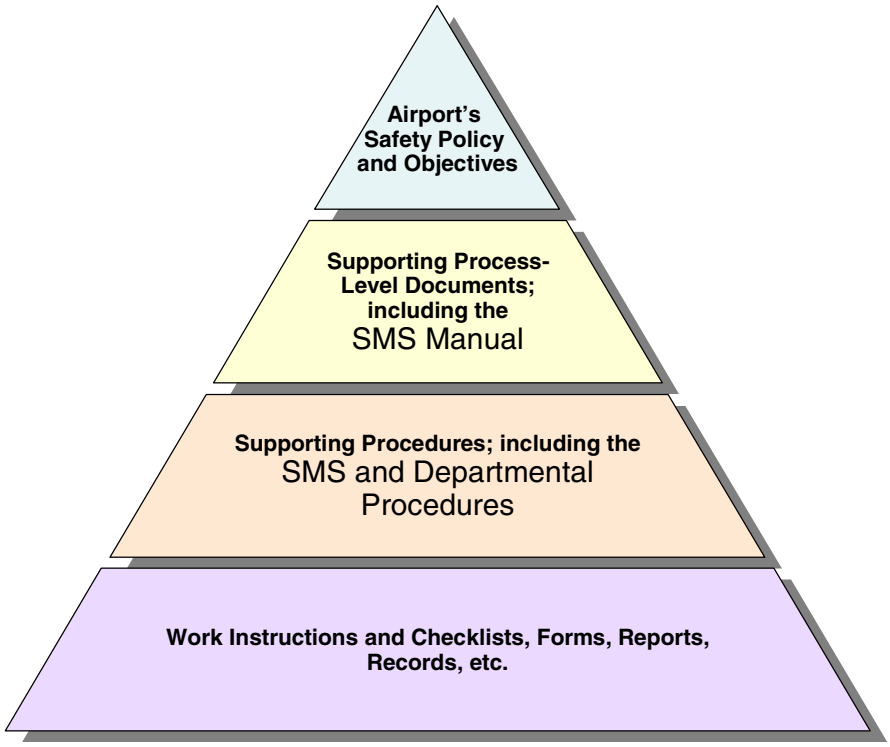


Figure 3. Levels of SMS documentation.

If a certain department already has a documented accident investigation procedure in place, the SMS documentation will make reference to that procedure when describing the related SMS pillar, instead of including (or repeating) it in the SMS documentation.

For example, some airports have a risk management office that may have specific procedures that can be adapted and used for any type of accident in the airport. In most cases, the office of public safety has investigation procedures that can be modified for the identification of root causes of accidents and incidents.

The extent of an SMS manual can vary from 5 pages in a very small airport to 50 pages or more in a larger airport.

The contents of an SMS Manual may include all or part of the following sections:

- Policy statement
- Objectives and goals
- Organizational structure for SMS
- Definitions of responsibility and accountability
- Procedures for safety performance measurement and monitoring
- Hazard reporting procedures

- Procedures for hazard identification
- Procedures for risk assessment
- Procedures for risk control
- Procedures for accident investigation
- Terms of reference for safety committees
- Procedures for document, record, and data management and control
- Procedures for safety communication
- Procedures for audits
- Procedures for management review
- Procedures for creating or modifying SOP
- Others as needed

Preferably, the SMS manual should contain only documentation that is not subject to frequent changes. Approving the SMS Manual may be a very time consuming process, particularly at medium and large airports, where the approval process may go all the way to board level. For example, one of the sections in the SMS Manual is "Objectives and Goals." This section describes the process to set goals and objectives, possibly the frequency that these goals are modified, and points out the appendix of the SMS Manual where these goals can be found; however, the actual goals and objectives should be part of another document that can have a different approval process, and this document is incorporated as an appendix to the SMS Manual. Goals and objectives may be changed every year and sometimes are set by specific airport departments and sections, without the need to go to board level for approval. Once goals or objectives are modified, the appendix can be replaced without the need to approve the entire SMS Manual.

CHAPTER 4

SMS Implementation

This chapter addresses the initial implementation of SMS and the implementation and management of continuous improvement initiatives. A phased approach usually is preferred because it has less impact on existing airport activities and it delineates more manageable tasks.

The goal is to have a structured SMS implementation plan designed to guide the airport organization through the initial transition to SMS. This plan of action identifies a step-by-step process on how to get from where you are now to a fully functioning SMS. The plan should identify who does what, when, and timelines for completion.

After completing the gap analysis and writing the documentation, as described in Chapter 3, there are five more steps:

1. Develop an SMS implementation plan
2. Obtain the approval of the airport safety policy and safety objectives
3. Appoint the person who has the responsibility for operating the SMS
4. Implement each SMS process that has been adapted or created
5. Provide SMS training (described as the final step even though some functions, such as the SMS Manager, will require training throughout—or even before—the implementation process has started)

Some airports may decide to limit the SMS scope to airside activities and extend the scope to activities on the landside and terminal areas later. Other airports may define their SMS scope for all airport activities from the very start. In all cases, a plan and a systematic method for implementation is critical to the initial success of the SMS.

In addition to the sections describing each of these steps, this chapter also highlights some proven practices (Section 4.6) and common challenges (Section 4.7) that you may face during the SMS implementation.

4.1 Develop an Implementation Plan

Once you have identified and documented your gaps, you will have a snapshot of where your organization is now in comparison to where you need to bring it to have a complete SMS. This will be your baseline.

You can look at the documented gaps as a set of tasks that need to be completed to achieve a functioning SMS. Project management principles apply here. As with any other project, you need to assign responsible persons for each task, provide the necessary resources to carry out the task, and define a timeline to complete each task.

The typical contents of an SMS implementation plan are depicted in Table 5 and an example schedule is shown in Figure 4.

Table 5. SMS implementation plan.

Item	Task	Description
1	**EXECUTIVE SUMMARY**	Brief background and objectives of the project
2	**IMPLEMENTATION SUMMARY**	Summary table with tasks, subtasks, phase, person responsible, duration, and estimated costs for implementation
3	**PHASE 1**	
3.1	Appoint and train Implementation Team	List of appointed members of the implementation team along with their associated responsibilities. The team should receive SMS training before starting upcoming tasks
3.2	Develop and Document Safety Policy	The safety policy is to be written, approved, and signed by the Accountable Executive and communicated to all airport workers
3.3	Develop and Document Safety Objectives	The safety objectives are written, approved, and signed by the Accountable Executive and communicated to all airport workers
3.4	Define and Document Safety Accountabilities	Document responsibilities for airport safety and use them on job descriptions as they relate to SMS[25]
3.5	Develop and Document SMS Organization Chart	The SMS organizational chart is prepared and approved by the Accountable Executive
4	**PHASE 2**	
4.1	Develop Process to Track Changes in Legal Requirements and Standards	Define and approve the process to identify, access, and evaluate current laws, regulations, and internal organizational requirements that are applicable to the safety aspects of airport activities
4.2	Establish SMS Documents and Records Management Process	Define the process for the approval, review, distribution, and disposition of SMS-related documents and records
4.3	Establish Process to Maintain SMS Data	Define the process for the identification, management, and disposition of safety data
4.4	Establish Non-Punitive Reporting System	Develop, maintain, and document a non-punitive reporting process
5	**PHASE 3**	
5.1	Internal Safety Investigations	Develop and implement the process to conduct accident and incident investigations to determine root causes
5.2	Proactive Processes for Hazard Identification and Reporting	Describe and implement the processes for hazard identification and reporting
5.3	Process for Risk Assessment	Document and implement the process for safety risk management
5.4	Process for Establishing Risk Control Action Plans	Define, document, and implement the process to develop risk control action plans, assign responsibilities, and obtain approval
5.5	Create Safety Committee(s)	Define, document, and approve the terms of reference for safety committee(s)
5.6	Process to Use Results of SRM to Improve Operating Guidelines	Document and implement a process that will trigger the review or creation of SOPs for continuous safety improvement of airport activities
5.7	Process for Evaluating Impact of Changes	Introduce a process to trigger risk assessments for significant changes at/on the airport

Table 5. (Continued).

Item	Task	Description
6	**PHASE 4**	
6.1	Process for Performance Monitoring	Implement a process to monitor safety trends, expressed in terms of performance indicators
6.2	Process for Management Review	Implement process for management review of SMS performance
6.3	Process for Safety and SMS Assessments	Create operationally independent assessment function with the authority required to carry out an effective internal safety evaluation program
6.4	Develop Training Program	Develop and implement process for evaluating current training programs and creating an SMS training program
6.5	Develop Safety Communications and Promotion Programs	Implement process to ensure that safety information is communicated to and from personnel
7	**PHASE 5**	
7.1	Extend SMS Scope	When required, this phase is used to extend the initial SMS scope (e.g., from airside only to all airport activities) and coordinate with SMS from stakeholders, when available
8	**SCHEDULE**	Scheduled periods for each task (see Figure 4)

When setting your timeline, try to be realistic while maintaining a continuous pace of implementation. It will demonstrate management commitment and will increase the chances of success. People tend to lose their initial motivation if the process is interrupted. Be sure to build in sufficient time for scheduling meetings and to evaluate progress.

4.2 Obtain Approval of Your Safety Policy and Objectives

You will need to have your safety policies and objectives approved following the preparation of the SMS documentation. These elements should be approved by the Accountable Executive to provide management support and commitment to the SMS and its implementation. In most cases, these elements are developed during the preparation of the SMS documentation; however, it is important that you know how to go about these two SMS elements.

Develop a Safety Policy

The first step when undertaking any journey is to know where we are going and how we are going to get there. This is what a safety policy does for SMS.

This policy speaks to high-level concepts. The policy should clearly identify and record the safety roles and responsibilities within your airport organization. To translate policy into executable actions, you will also set measurable objectives and goals. They provide a way to identify desired outcomes and a realistic way to achieve them.

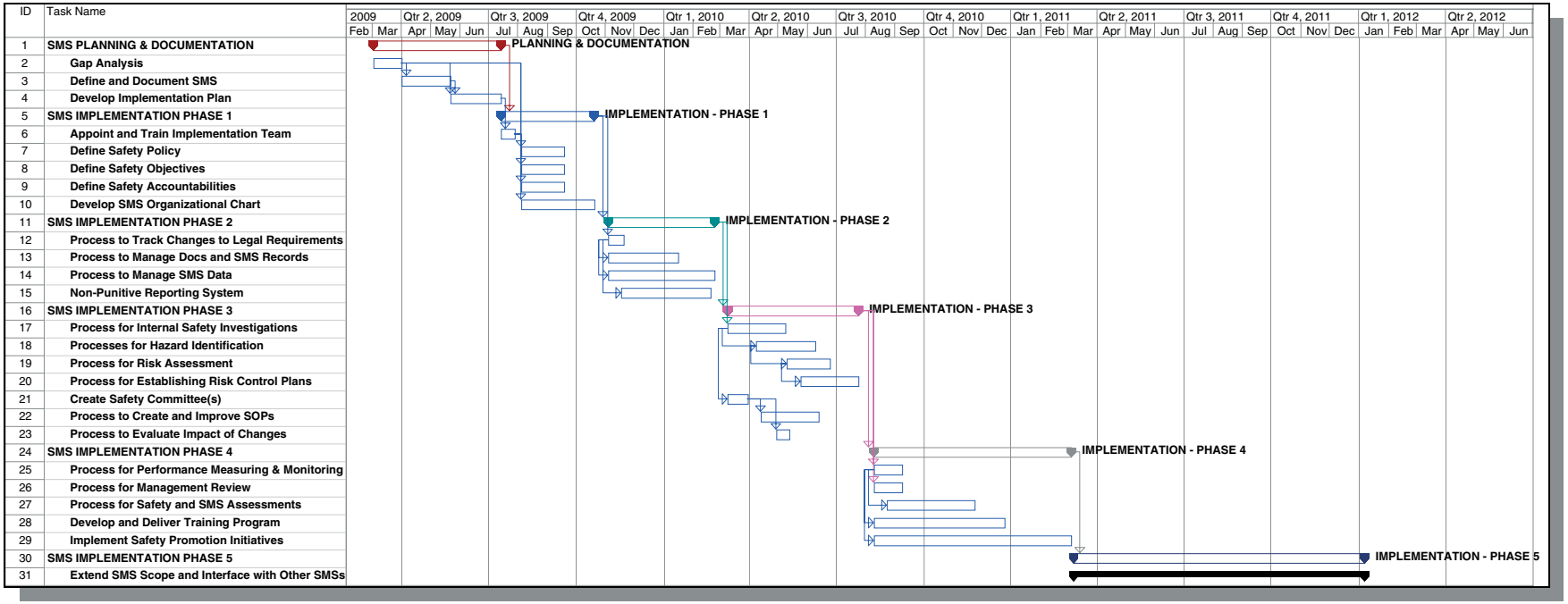


Figure 4. Example schedule for SMS implementation.

One way to develop a safety policy is through a round table discussion with the management team (you might consider employee participation as well). You could start by collecting existing policies (written or not). Identify what is important to you as an organization (with regards to safety), including significant risks, legislation, regulations, and standards.

One key element of a safety policy statement is the reporting policy. The most effective way to obtain information on hazards and other safety issues is to establish a non-punitive reporting policy, where people are not punished for making an honest mistake.

One policy statement might include "we will work to be the safest airport in the region." This could lead to the following safety objective: "reduce the number of incidents on the apron to at least 10% below regional average." To achieve this objective, you may set up the following goal: "reduce the number of incidents by half in the next 3 years."

However, it is very important to note that objectives and goals should not be part of the airport's safety policy statement.

A safety policy is a clear indication of management commitment toward safety. It should be widely publicized. A safety policy should be appropriate to the size and complexity of the airport and typically should contain at least the following elements:

- A commitment to make safety the highest priority
- The commitment of senior management to implement SMS
- A commitment to continual safety improvement
- The encouragement of employees to report safety issues without fear of reprisal
- A commitment to provide the necessary safety resources
- A commitment to comply with all regulatory requirements for the airport operation

There is no prescribed length for a policy statement. In most cases, a single page should be enough to include at least these elements.

Example of Safety Policy (courtesy of Lexington Blue Grass Airport)

We all have the responsibility for working in a safe manner. The application of an effective safety management system is integral to all our aviation activities, with the objective of achieving the highest levels of safety standards and performance. As such our commitment is to:

- continuously promote a safety culture across all our activities that recognizes the importance of safety and the value of effective safety management;

- ensure that all staff are aware of their accountability and responsibility in the execution of and participation in the safety management program;
- proactively manage the risks associated with accidents or incidents to a point which is as low as reasonably practicable/achievable;
- verify that all externally supplied systems and services that impact upon the safety of our operations meet appropriate local, national and contractual safety standards;
- comply with and wherever possible exceed legislative and regulatory requirements and standards;
- provide all our staff with adequate and appropriate safety information and training, to ensure that they are competent in the performance of their duties;
- measure our safety performance against objectives or targets on a regular basis, and take mitigation control actions to improve safety when appropriate;
- strive for the highest levels of safety standards and performance in all our activities;
- continually improve our safety performance; conduct safety and management reviews; and ensure relevant actions are taken.

We encourage uninhibited reporting of all incidents and occurrences that may compromise the safe conduct of our operations. To this end, every employee is responsible for communicating any information that may affect the integrity of airport operations. Such communication is completely free of any form of reprisal; however, this policy shall not apply to illegal acts, or deliberate, or willful disregard of promulgated regulations or procedures.

..... [Signature & seal] .....

Joe Smith—Executive Director—XYZ Airport

Ensure that the policy is up to date and signed by top management. Document and share this policy with all employees and contractors. It should be written in clear and simple terms and clearly visible (posters, website, company documentation, etc.). In addition, management should be available to explain and discuss safety policy with employees and business partners as required. The process to approve the safety policy depends on the airport organization; however, the Accountable Executive is the person that should sign it.

Define Objectives and Goals

Overview

Most of us respond to a challenge and perform better when we are aiming at a goal. Management system practices recognize this and require organizations to set objectives for themselves. These objectives need to be measurable or have associated targets. Alongside your airport's policy and SMS best practices, these objectives and targets help to focus the management system.

An objective is a statement of a desired outcome. With a clearly defined target, we can establish whether we have made the desired improvement. In many cases, we may be able to track progress

as we work toward the target. Before setting an objective or target, we need to know the current situation, which might require some form of data or statistics.

Because these objectives need to be measurable, it is necessary to define a safety performance indicator (SPI) associated with the goal. An SPI is any variable used to measure changes in the level of safety.

When setting objectives and goals, people tend to focus more on defined targets and less on other safety issues not related to the established targets. However, not all airport hazards are represented by the safety objectives and goals.

The overall airport objectives often will be achieved through accomplishing numerous contributory objectives and targets from airport departments and sections. This is sometimes referred to as the *cascade effect.*

Cascade of Objectives

As an example, let's say that the airport manager has set a target of reducing ramp accidents by 25% in 1 year. Data have shown that one of the main causes of ramp accidents at this airport is speeding by ground vehicles. Therefore, the Department of Public Safety will set an objective to enforce the airport maximum speed of 20 mph at the apron to reduce speeding violations at the ramp by 40%. Other departments/sections will set their own objectives as well, so that the overall airport objective of reducing ramp accidents by 25% can be met.

There may be several opportunities for improvement by various airport departments, sections, or units that may contribute to the overall situation. The efforts should be prioritized where the greatest gains can be achieved. Using the same example, in a large airport with more than one apron area, it is possible that accidents are occurring mostly in one of the ramps. Each airport unit may then be given different targets that reflect its scope for improvement.

We may also find that, having looked at all the contributing factors, we can only realistically expect to hit an 8% reduction in ramp accidents this year. Our original intention for an overall target of 25% needs to be scaled down slightly. After all, there is little point in setting a target that the airport cannot achieve.

An airport should set SMART safety objectives:

Specific:	The objective or target should be focused on one thing only
Measurable:	It should be possible to measure whether or not you hit the target
Achievable:	The target should be within your capabilities
Relevant:	The objective should be something of importance or significance for safety
Timed:	There should be a deadline for achieving the target

Examples of Airport Objectives and Goals

Table 6 presents some typical safety objectives and associated goals used by airports.

Table 6. Typical airport safety goals and objectives.

Objective/Goal		Description
Objective		Implement a safety management system for the airport in 2 years
	Goal	Install a non-punitive reporting system in 1 year
	Goal	Implement a document and records control system in 6 months
	Goal	Provide basic SMS training to airport employees in 1 year
Objective		Reduce number of airside accidents by X% in 1 year
Objective		Reduce number of airside incidents by X% in 1 year
Objective		Reduce number of ramp accidents by X% in 1 year
	Goal	Reduce number of speeding violations at the ramp by X% in 1 year
	Goal	Develop and enforce airside rules and regulations in 6 months
	Goal	Reduce number of airside driving infractions by Y% in 1 year
	Goal	Create and implement five airside SOPs in 6 months
	Goal	Reduce number of incidents involving damage to stationary aircraft by Y% in 1 year
	Goal	Reduce number of incidents involving damage to moving aircraft by Y% in 1 year
	Goal	Reduce number of incidents involving passenger handling equipment by Y% in 1 year
	Goal	Reduce number of incidents involving aircraft loading equipment by Y% in 1 year
	Goal	Reduce number of incidents involving aircraft service equipment by Y% in 1 year
	Goal	Reduce number of incidents involving jet blast by Y% in 1 year
	Goal	Reduce number of incidents involving passenger handling equipment by Y% in 1 year
	Goal	Reduce number of incidents involving fuel spillage by Y% in 1 year
Objective		Reduce number of job related injuries at the ramp by X% in 1 year
Objective		Reduce number of runway incursions by X% in 1 year
Objective		Reduce number of bird strikes by X% in 1 year
	Goal	Reduce number of bird strikes by Y% during the summer
Objective		Increase the number of training sessions by X% in 2 years
Objective		Reduce number of FOD occurrences by X% in 6 months

Safety Performance Indicators

SPIs are measurable parameters that are related to the airport's safety objectives and that address the main hazards and incidents at the airport. These measurements should be based on information of causal factors or specific types of incidents, so that SPIs associated with this type of undesirable event can be mitigated. A large number of potential SPIs exist; however, not all of them are equally important. In general, the importance of an SPI can be assessed in terms of the strength of its relationship with accident or injury occurrence, that is, if it makes a major contribution to accidents and if it can be influenced by safety measures or programs. When possible, the SPI should focus on latent conditions and near miss events (incidents), instead of accidents.

- Not everything needs to be measured
- Not everything can be measured
- Some of these indicators can be misleading (e.g., number of violation tickets)

A non-exhaustive list of common SPIs used by airports follows:

- Number of airside accidents
- Number of airside incidents
- Number of job-related injuries at the ramp
- Number of job-related injuries at other airside areas
- Number of runway incursions
- Number of incidents involving wildlife
- Number of airside driving infractions
- Damage to stationary aircraft
  - By passenger handling equipment
  - By aircraft loading equipment
  - By aircraft service equipment
- Damage to moving aircraft
  - By another aircraft
  - By jet blast
  - By gate guidance procedure
  - By fixed objects
  - By parked ground equipment
  - By FOD
- Property/equipment damage from jet blast
- Equipment to equipment damage
- Number of spillage incidents
- Number of training sessions delivered

In most cases, the number of accidents can provide a good indication of trends but may not help identify the processes that lead to those accidents. Therefore, a good SPI should have the following characteristics:

- Able to reflect a causal link between a latent condition and possible accidents
- Easily measured
- Objective
- Consistent across time

More SPIs do not necessarily mean a better system because

- There will be more work to track them
- They dilute the important information
- They discourage people from collecting the information
- The performance monitoring system may fail
- It is better to start small

SPIs can be misleading

- **Numbers that are not normalized** (e.g., use number of accidents per 10,000 operations, rather than simply the number of accidents)
- Numbers that are subject to misinterpretation
- **Random variations** (e.g., a drop from 3 accidents in a month to 1 accident in a month may be associated to random variation and may not represent a real trend)

An SPI should originate in the safety objectives and goals selected by the airport and should be based on factors that can contribute to undesirable outcomes and accidents. An example of the ideal process to select an SPI is presented as follows:

1. Consider the safety objective: reduce apron collisions by 20%
2. Analyze the causal factors that contribute to associated risk
   a. Speed
   b. Low visibility
   c. Lack of familiarity with the apron layout
   d. Incorrect equipment positioning
3. Determine the safety targets
   a. Reduce speed
   b. Improve visibility
   c. Improve familiarity
   d. Improve equipment positioning
4. Determine what data may be required
   a. Speed, location, and time of day
5. Collect data
   a. Install speed reading devices at key locations
6. Analyze data to identify where and when the violations are more frequent
   a. You find that speeding occurs mainly in one area and during peak hours
7. Refine actions that could improve safety in the areas selected
   a. You decide to install speed bumps in the area where most of the speeding occurs
8. Assess data trends to see if the actions are working or not
   a. Monitor speeding trends in this area—is speed reduced?
   b. Monitor number of collisions per month—does it go down?
      - If yes, speeding in this area is a good SPI
      - If not, you need to look at the data again and come up with new actions
9. Select the SPI

Normalizing accident rates makes these numbers comparable

To normalize your rates you can multiply your annual accident rate by 10,000 movements and divide by the total number of movements during that year. In this case you are normalizing for 10,000 movements per year.

For example, a large airport had 3 runway incursions in 2007. During that year, the number of movements was 200,000. The normalized rate is 0.15 ($3 \times 10{,}000 \div 200{,}000$) incursions per 10,000 movements per year.

The normalization technique helps you compare the rates if your annual number of movements changes and even compare them with the rates for other airports.

4.3 Appoint the SMS Manager

SMS is based fundamentally on processes and procedures. If not already in place, these will need to be developed, implemented, and coordinated. Therefore, SMS requires a person responsible to coordinate the integration and the everyday administration of these processes.

It is common that the airport management has not decided who will be the SMS Manager before the SMS program is developed and implementation starts. The term SMS Champion is used to make clear that the person responsible for the SMS implementation is not necessarily the person who will run the SMS. However, whenever possible, the SMS Champion and SMS Manager should be the same person.

Similar to the SMS Champion, who is in charge of the SMS implementation, the SMS Manager should have access to both top management and line personnel; the SMS Manager should be knowledgeable in the operational activities of the airport and be respected by the whole organization.

Depending on the size of the organization, the SMS Manager could be dedicated full time to this function, or this responsibility could be added to existing duties. For example, the SMS Manager could be supported by a team of members from within the organization as required.

An SMS Manager could be appointed at the end of the implementation process; however, it is recommended that the SMS Manager get involved as early as possible and have input during the development. Early involvement will help once the manager becomes responsible for daily administration of the system.

At the discretion of each airport, the following are the main characteristics to be considered for the selection process of a good SMS Manager:

- Knowledge of the FAA documents and regulatory requirements
- Knowledge of the aeronautical system, safety, and SMS processes
- Experience with airport activities associated to the SMS scope
- Basic theoretical and practical training accomplished for the function
- Familiarity with the functions of the position including:
  - Airport safety risk management
  - Principles of organization and management
  - Management and control of SMS processes
  - Process auditing, mitigation, and corrective actions and feedback
  - Basic knowledge of airport accident/incident investigations
  - Basic knowledge of statistics
  - Basic knowledge of performance, performance indicators, and trend analysis
- Dynamic and capable of making correct and timely decisions about safety issues
- Solid written and oral communication skills
- Ability to relate to airport staff and stakeholders
- Familiarity with airports reporting systems
- Leadership and capacity to influence SMS staff to support safety promotion initiatives
- Computer literacy

Each airport should establish the minimum requirements for the SMS Manager job function according to its characteristics and needs.

4.4 Implement Each SMS Process

At this stage, you should have a clear picture of where you are going (safety policy), the person willing to take you there (SMS Manager), and management support (to provide the necessary support and resources). Now you need to define the vehicles that will make SMS possible. In other words, define the SMS elements and develop tools to support their execution. The development process should consider the integration of those elements already in existence within the airport organization, as well as the development of new ones.

4.5 Provide Training to SMS Staff

As with any other business or operational activity, SMS will be most effective if the players are competent in performing their duties and are aware of the tools available to them so they can have meaningful participation in the system. Everybody should receive SMS training, initially and on an on-going basis. However, not all personnel should receive the same level of training. A recent hire probably will need to know the basics of SMS and learn how to follow certain procedures (produce a report, for example), whereas the SMS Manager will most likely need to know about risk management, safety investigation, and interviewing techniques. Information on levels of training and suggested programs is found in Section 6.8.

Figure 5 illustrates these SMS implementation steps and references for all of the SMS elements described in Chapter 2.

4.6 Proven Practices

The following approaches to SMS implementation have been used and proven effective in both the aviation industry and other high-risk industries.

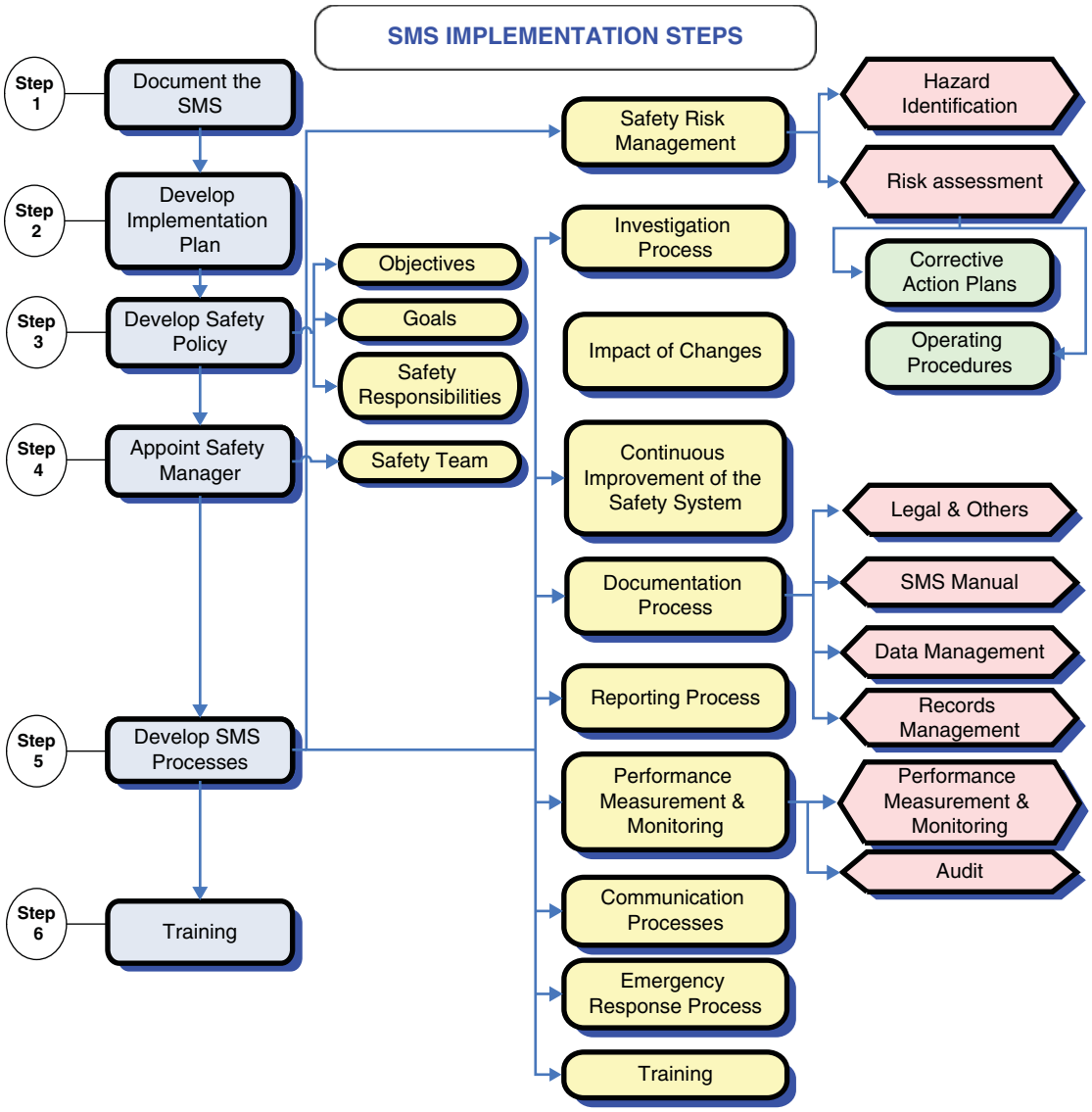


Figure 5. SMS implementation steps.

Phased-In Implementation

For an SMS to be effective, a culture change in the organization may be necessary. This does not happen overnight. A successful implementation will require steady, consecutive small steps that allow people the time they need to understand them, get used to them, and eventually embrace them.

SMS will require the integration of existing processes and, in many cases, the development of new ones. These tasks of integrating and developing will probably require the personnel involved in SMS implementation to acquire new skills.

You will need to build confidence within management and line personnel. Both management

A phased implementation allows for gradual and controlled changes to existing practices. People must be prepared for such changes. Too many new initiatives in a relatively short period of time can be overwhelming.

and line personnel will need to accept this new way of doing business, and more often than not, positive results will need to be demonstrated before the next step can be taken. For example, if you decide to start with a reporting system, make sure that the reports submitted receive a timely and appropriate response.

If employees do not see any action (or at least acknowledgement) when they report a safety issue, they likely will stop reporting. If this happens, it will take a much larger effort to get the reporting process re-started.

Once you set up your action plan, start implementing one process at a time. Make sure that each element is achieving the desired goals before moving on to the next. Promote each SMS process throughout the organization at every phase of implementation so that all employees understand how it works, what its purpose is, and how they can help.

Use Existing Processes and Procedures

Many of the processes that are needed to satisfy SMS requirements probably already exist within your airport organization to some extent. For example, many airports have an accident investigation process or an incident/accident reporting system. Make use of as many of your existing processes as you can and integrate them within the SMS context. This will save you a lot of development time and effort, as well as the time to familiarize employees with the process.

Select the Right People for Key Positions

An enthusiastic individual who is willing to learn will do a lot more for the collective effort than somebody with no interest in getting involved. Someone who may be less qualified but is very enthusiastic could be more valuable to the process.

Get Everyone Involved

Ask for employee feedback whenever possible. People are more likely to take ownership and pride in things that they helped develop.

Advertise planned activities and request suggestions from staff. Allow participation in process development workshops and create work groups to address specific issues.

Keep it Simple

It is extremely important that processes and tasks are kept to a level that is well understood by all. Avoid long, academic discussions and explanations because it will do very little to support the broad understanding at all levels that SMS requires.

The processes developed to support SMS do not have to involve the latest piece of software or a sophisticated methodology used by the research department of a university. A reporting system based on a simple paper form available at every location may do a lot more for you than a software-based tool with access only at selected sites.

Communicate, Communicate, and Communicate!

Successful SMS implementation requires buy-in from the whole organization. Early on, develop a communication plan to ensure that everybody is aware of the new upcoming changes, the need for employee support, and opportunities to get involved.

SMS seeks to provide an integrated system of safety processes within an organization. It involves all levels of personnel and departments, and it can certainly benefit from the sharing of information and expertise between departments.

Do not create another silo (isolated group) with SMS!

Airports, like other organizations, tend to develop a collection of silos or relatively isolated groups that have different vocations and cultures resulting from previous training, education, and experience. There is always the danger of creating a new silo when bringing SMS on board.

If miscommunication is an issue in your airport (e.g., language barriers[26]), a little money spent to improve it and make sure training and safety procedures are well understood by everyone can save you a lot of money in accidents avoided.

Labor Unions

Labor unions are generally supportive of any organizational change that can bring about an improvement in employee well-being and working conditions. SMS certainly falls into this category. The organizational and administrative structure of these organizations can provide a forum for the sharing of information and employee commitment. Possible means to engage labor unions in the SMS processes include explaining the SMS, how the system will be implemented, and their specific roles to support it (e.g., getting them involved in the development of non-punitive reporting systems; defining safety objectives; etc.).

4.7 Common Challenges

Management Commitment

You will never hear management say that they want an unsafe airport; however, it sometimes is hard to get the resources required to make your operation as safe as you want it to be. Traditionally, organizations view safety as an expense or nothing more than a regulatory requirement. It may be difficult to convince management that they need to invest in safety, especially if the air-

port already has a good safety record. If management's commitment to safety is to be believed and acted on by the airport organization as a whole, management has to show commitment through real actions—allocation of the necessary resources to implement and maintain an SMS, participation in safety events and activities, and so forth.

To address this challenge, you could discuss with management the many benefits of SMS. Communicate that not investing in safety actually can cost more in terms of time, money, reputation, and potentially unrecoverable losses.

Behavioral Change

SMS will require change, and people are naturally resistant to change. Too often, the importance of this human characteristic is disregarded. If not handled properly, it can lead to misunderstanding and frustration.

Change takes time. Do not get discouraged. Any initial negative reaction could be mitigated by trying to maximize the integration of existent practices, making staff part of the process by sharing responsibilities with them, and taking a phased-in approach to implementation, leading by example, creating forums for open communication, etc.

Maintaining Momentum

SMS implementation will require a continuous and consistent effort. There is a need to plan the development phase carefully to ensure that all efforts are designed to obtain the greatest return and that, once they are started, these efforts will not be interrupted by foreseeable events.

Cultural Characteristics

Different backgrounds define our values and beliefs. This impacts how different groups interact with each other. SMS is mainly about cultural change. The steps you take to effect the desired change have to be harmonized with the culture of the organization as a whole while respecting the distinctiveness of every group.

When you design SMS processes, make sure you take into consideration cultural differences. For example, certain societies cherish openness and sharing of information, while others are more reserved. If an organization has a significant number of members that belong to each of these two groups, a reporting system that does not respect and guarantee confidentiality and anonymity might draw much information from the first group but not from the second. This would limit the value of the information collected and the effectiveness of the whole process.

Taking Responsibility for Safety

Traditionally, a Safety Officer or SMS Manager has been looked at as the only person responsible for safety within the organization. If somebody raised a safety concern, he/she was told to address it through the safety office. SMS intends to change that. Safety is a responsibility that is shared by all parties and integrated into the everyday operation.

To address this challenge, you should discuss with line management that safety is their responsibility and that the SMS Manager's role is to support them in the fulfillment of this task. This support can be given by offering advice, coordinating safety activities, sharing information, and providing an independent view when it comes to incident and accident investigations.

Airport Stakeholders

Most aviation organizations employ a number of service providers, contractors, and suppliers on a temporary or permanent basis to support operational and administrative activities. In short, the operating environment is not necessarily isolated, but shared by many other organizations that are not directly under its control. The degree of interaction with these stakeholders varies, but almost inevitably, their activities will interface or overlap during operational practices.

Some of these overlaps are obvious (e.g., an air operator with a ground handler). In these cases, their business "link" is direct and apparent. Normally, a contractual obligation provides a mechanism for discussion and coordination of business activities, including safety. Other relationships are not so apparent (e.g., airport operator and air traffic control). There may be direct overlapping of operations without a direct administrative link that allows for coordination.

All interactions with airport stakeholders should be part of an organization's SMS. At the very least, the interfaces should be reviewed to ensure that they do not compromise safety. An organization has responsibilities for its activities. So when it contracts out functions, it must assure itself that the contracted company does not endanger the organization's own SMS. One possible means to achieve this objective is to incorporate into contracts and leases some clauses that facilitate the integration of critical safety elements such as communication, training, agreement to follow the airport rules and regulations, reporting of incidents and accidents, and so forth.

If there is no obvious link between your organization and the third parties in your airport environment, *create one.* Where your operations overlap, provide the necessary link for coordination of safety processes and practices and sharing of information. For example, if an FBO rarely participates in any coordination activity within the airport, members of the FBO can be invited to integrate such committees when you create a safety committee.

CHAPTER 5

Safety Risk Management

SRM is the core process behind SMS. It is through SRM that an airport will be able to determine and classify risks to develop appropriate risk mitigation strategies. According to FAA AC 150/5200-37, "SRM is a systematic, explicit, and comprehensive approach for managing safety risk at all levels throughout the airport."[1] The SRM process ensures the following:

- Hazards and other safety issues are identified and documented. The associated risks are mitigated, monitored, and controlled
- Risk is determined, assessed, and classified. Unacceptable risk is mitigated
- Corrective actions are taken after accidents and incidents
- The effectiveness of the risk mitigation strategies is monitored and assessed
- There is continuous progress toward improving safety

Realistically, some risk must be accepted. How much is accepted or not accepted by the airport organization is still a prerogative of the Accountable Executive. This chapter provides some recommendations on risk tolerability that may be used by airports. When an Accountable Executive decides to accept a risk, the decision should be coordinated with the affected personnel and stakeholders, and then documented so that, in the future, everyone will know and understand the elements of the decision and why it was made.

The SRM process and its five steps are explained in this chapter. In addition, this chapter also describes how to use the risk matrix, presents a list of common airport hazards with associated risks, and describes a complete example of the SRM process for several airport hazards.

5.1 The SRM Process

SRM is a process for controlling risk in an organization. There are different levels of risks. Some are unacceptable for airport activities. With SRM you will be able to identify those risks that require specific actions to reduce them to acceptable levels. Moreover, you will be able to classify and prioritize the risks so that you can make the best use of your limited resources.

The SRM process is depicted in Figure 6. It comprises five steps:

1. Describe the system
2. Identify hazards
3. Determine risk
4. Assess and analyze the risk
5. Treat and monitor risk

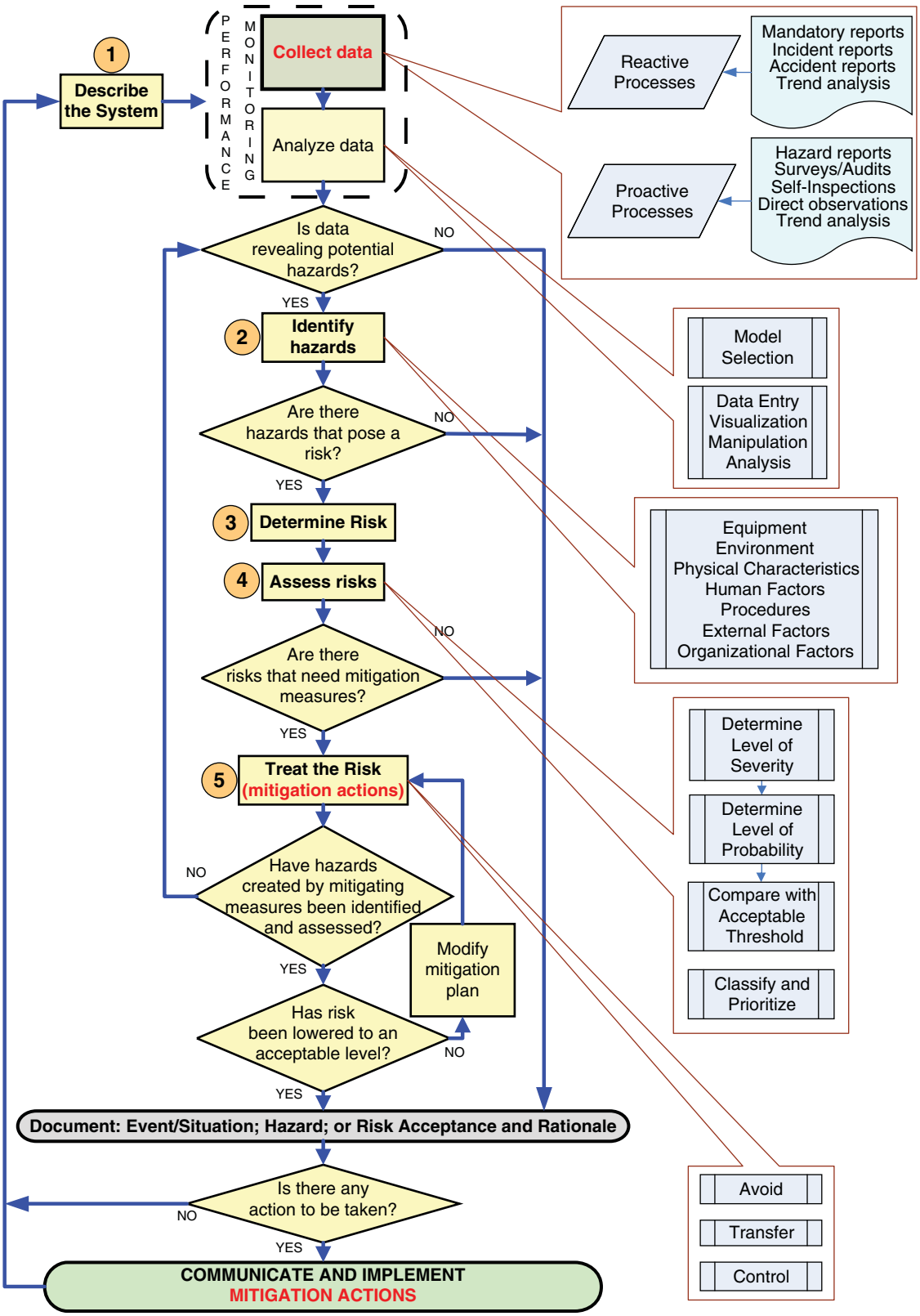


Figure 6. SRM life cycle.

These steps should be applied in sequence as each is a building block for the next one. It is important to complete each step before proceeding to the next. Until the hazard identification step is complete, it is not possible to properly prioritize risk control efforts.

Each of these steps is described in detail in this chapter. An example of the application of the SRM process is presented in Section 5.7.

5.2 Describe the System

The first step in performing SRM is to describe the system under consideration. The system description should include the functions, general physical characteristics and resources, and operations of the system.

When considering the environment of the airport system, consider all of the safety-related functions already outlined in the ACM. The existing safety functions should steer the focus of the risk management analysis and will assist in determining potential risk control strategies.

Normally, for airport hazards, a detailed physical description is not necessary. It may be easier to consider the system as an activity, such as a ramp operation, or in terms of the physical area involved (e.g., Taxiway D or airside). The main objectives of identifying the system are (1) to characterize, limit, and document the scope of the problem or change and (2) to identify stakeholders.

In general, a model is used to remind you what should be described to characterize the system. While there are many models available, the model called "5M" is simple and takes into account the interrelationships and integration of the equipment, people, environment, and procedures of the system. The 5M model has five components:

- ***Mission:*** It is the airport activity or the reason that all the other elements are brought together. Example: operation for transporting baggage from parked aircraft to baggage claim area.
- ***Man:*** This is the human element of a system. If a system requires humans for operation, maintenance, or installation, this element must be considered in the system description. For example, an airport construction activity is conducted by contract workers and monitored by airport staff. This group of people and the people they interact with during the construction activity constitute the human element of this system.
- ***Machine:*** This is the equipment element of a system. Example: the operation to transport baggage on the ramp may require a baggage tug and baggage carts.
- ***Media:*** It is the environment in which a system will be operated, maintained, and installed. This environment includes operational and ambient conditions. Operational environment means the conditions in which the mission or function is planned and executed. Operational conditions are those involving things such as volume of traffic, communication congestion, and workload. Ambient conditions are those involving temperature, humidity, light, precipitation, visibility, and so forth. An example is winter operation conditions.
- ***Management:*** This element includes the organization, procedures, policy, rules, and regulations involved in operating, maintaining, installing, and decommissioning a system. Example: a construction activity will involve engineers, contractors, and inspection personnel and can involve several procedures and construction specifications: escorting construction equipment on the airside, signaling the construction area, specific procedures to mitigate FOD, and so forth.

Figure 7 shows a graphical representation of the interactions among these elements.

An example of a system is depicted in Figure 8. Construction is taking place on the airfield. In this case, the system is daytime construction work (replacement of drainage pipes) taking place close to the intersection between Taxiway D and the Runway 5 arrival end.

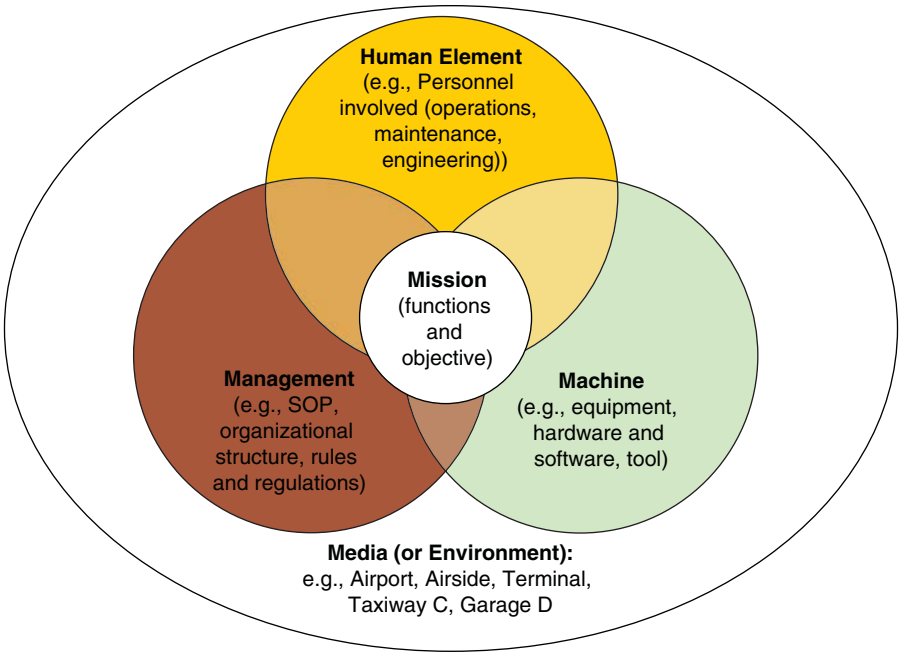


Figure 7. The "5M" model.

5.3 Identify Hazards

FAA AC 150/5200-37 defines a hazard as "any existing or potential condition that can lead to injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a condition that is a prerequisite to an accident or incident."[1]

Understanding the hazards and inherent risks associated with everyday activities allows the airport to minimize unsafe acts and respond proactively, by improving the processes, conditions, and other systemic issues that lead to unsafe acts. These include training, budgeting, procedures, planning, promotion, and other organizational factors that are known to play a role in many systems-based accidents.

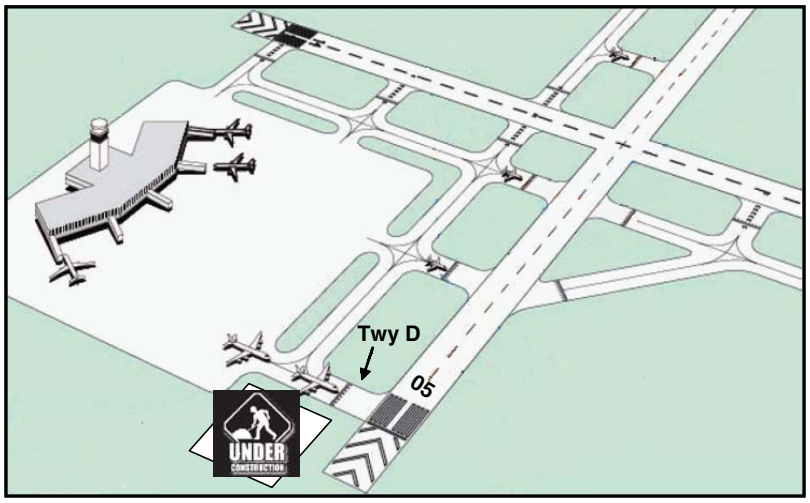


Figure 8. SRM example.

In this way, safety management becomes a core business function and is not just an adjunct management task. It is a vital step in the transition from a reactive safety culture—one in which the organization reacts to an event—to a proactive safety culture, in which the organization actively seeks to address systemic safety issues before they result in an active failure.

Although hazards are an ever present fact of airport operations, a hazard by itself may not have the potential to cause damage under many situations. It only results in risk when specific situations arise that could affect the continuity of airport operations. For example, rain is not necessarily a hazard; however, if the runway surface holds the water, there is potential for aquaplaning.

Some airport hazards may be obvious, such as speeding at the ramp. Others may be more subtle, such as using inexperienced staff to tow aircraft.

Hazard identification is the act of identifying any condition with the potential to cause injury to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function.

There is a common tendency to confuse hazards with their consequences.

Example: "runway incursion" is an outcome or consequence, not a hazard. In contrast, "unclear pavement markings" is a hazard that may lead to runway incursions.

The initial step in SRM is to identify the hazards that the airport faces in its operational environment. A description of the system or operation must be developed as part of this step. The key and simple question to ask is **what can go wrong?**

In an SMS, all identified hazards are documented and analyzed to determine what action is required to eliminate or reduce the safety risk associated with each specific hazard. Judgment is necessary to determine the adequate level of detail to describe the hazard.

Hazard identification techniques may be reactive or proactive in nature.

Reactive	*Proactive*
Trend Analysis (Accidents)	Trend Analysis (Incidents)
Accident Investigations	Self-Inspections
Occurrence Reporting	Change Analysis
	Hazard Reporting
	Brainstorming Sessions
	Checklists
	Hazard Analysis Tools
	SMS Assessment
	Interviews

It is important that hazard identification be conducted at all levels throughout the organization, because there is often a relationship between the hazards and activities conducted in one department and another.

> While identification of every conceivable hazard would be impractical, airports are expected to exercise due diligence in identifying significant and reasonably foreseeable hazards related to their operations.

Using the example illustrated in Figure 8, a couple of hazards can be identified:

Hazard Category 1—Construction Affecting Operations

- Workers and vehicles crossing runway/taxiway
- Construction debris
- Construction equipment interference with NAVAIDS

Hazard Category 2—Operations Affecting Construction

- Jet blast from aircraft accelerating to takeoff
- Aircraft excursions and undershoots

Once you have completed your first hazard identification exercise (spanning the whole area under your SMS scope), the process cycle should be continuous and include mechanisms to allow for periodic and ad hoc hazard identification exercises. Hazards are continuously identified and reported during daily self-inspections, observations, and hazard reports received from the available reporting system.

For other situations, the airport should also define triggers to initiate the process, identify who will be involved, and the proper way to record the findings and actions taken. It should also provide training to the participants. For example, a major change (see Table 17) may trigger the hazard identification process for that specific change.

Factors for Consideration

Hazard identification should consider every potential source of system failure, including equipment, the airport operating environment, and operational and maintenance procedures. Organizational and human factors to consider include the following:

- All persons having access to the workplace (e.g., airport workers, passengers, contractors, delivery personnel, as well as airport employees)
- The hazards and risks arising from their activities, the required skills and training to perform a procedure, and their varying behavior, medical conditions, and physical limitations
- The hazards arising from the use of equipment or services supplied to the airport and its tenants
- The hazards arising from operational practices and procedures
- The work environment (visibility, lightning, temperature and precipitation conditions, strong winds)
- Communications, including means, terminology, and language
- Regulatory factors, including the applicability and enforceability of regulations; certification of equipment, personnel, and procedures; and the adequacy of oversight
- Defenses, including detection and warning systems, and the extent to which the equipment is resilient against errors and failures
- Organizational factors, such as airport policies for recruitment, training, remuneration, and allocation of resources

Evaluating hazards associated with human factors should consider latent conditions. These are usually not obvious. The process should specifically address questions such as: How might staff misinterpret this procedure? How might a person misuse this function/system (intentionally or unintentionally)?

Hazard Identification Techniques

There are several means that the airport can use to identify hazards. In general, airside hazards are identified by the airport operations staff, in many cases, as part of Part 139 regulatory requirements for self-inspection. With SMS, the airport can use additional means. The most common ones used by airports are the following:

- **Hazard reporting**—this is an effective multiplier of the "eyes" of the airport to identify hazards because it is accessible to any person working (or not) at the airport
- **Visual inspection**—on the airside it is mostly performed under Part 139 self-inspections by airport staff; on the landside and terminal areas, maintenance and public safety staff can be trained to identify hazards
- **Checklists** (group review)—review of experience and available data from accidents, incidents, or similar systems to draw up hazard checklists that can be used to identify potentially hazardous areas that require further detailed evaluation

Checklists can be used as a reminder of what types of potential hazards to consider and to record the initial hazard identification; however, care should be taken to avoid over reliance on the use of checklists. Checklists should be specific to the work area, process, or equipment being evaluated.

- **Brainstorming** may be unstructured thinking (e.g., when major changes occur) or may be based on a review of an existing checklist. The group should consist of people with a wide variety of backgrounds with relevant experience and competence
- **Review of accident investigation reports** from your own airport or from other airports. Example: it would be difficult to identify all hazards leading to aircraft overruns if accidents from only one airport were evaluated
- **Change analysis** (construction, new equipment or facility, organizational changes, new regulation, etc.)
- **Information** from industry associations and advisory bodies
- **SMS publications and websites**
- **Professional advice**
- **Consultation and interviews** with employees/stakeholders
- **SMS and internal safety assessments**
- **Statistical analysis** of records and performance indicators (trend analysis)
- **Hazard identification tools:** (see Annex E)
  - **Functional hazard analysis**
  - **Change analysis**
  - **Job hazard analysis**
- **Information** from other management systems (Air Traffic Control (ATC)[27], airlines[28], environmental, wildlife, risk management, etc.)
- **Safety surveys**
- When an **unexplained increase in safety-related events or infractions** is identified

Some of these processes can be used in combination. For example, a change analysis due to construction may use a "construction safety checklist" to evaluate potential hazards during construction.

Improvised processes for hazard identification are unacceptable safety management practices. For example, simply telling airport staff to identify hazards will not work unless proper training is provided on how to identify and report hazards.

Recording Hazards

All identified hazards should be assigned a hazard number and be recorded in a hazard log. The log should contain a description of each hazard, its consequences, the assessed risk in terms of likelihood and severity, and any required mitigation measures. It should be updated as new hazards are identified and proposals for mitigation are introduced. Table 7 provides suggested information to include in a hazard log.

Common Airport Hazards

Table 8 presents several hazard categories present at airports. Each category is further broken down into specific components of the category. The third column provides some general consequences associated with the specific hazard category and its components. The list is not intended to be exhaustive, but to provide some helpful information that can be used to identify additional categories, components, and potential consequences.

5.4 Determine Risk

One of the best methods to identify risk associated to a hazard is a brainstorming session. Personnel involved in day-to-day operations are generally very familiar with "what can go wrong" situations. Another method is through lessons learned that are usually shared through industry publications and conferences or workshops.

An airport operator might have identified the storage of unsecured containers as a hazard on the cargo ramp. Risk associated with this hazard is a gust of wind or aircraft jet blast setting an empty container in motion and striking a passing aircraft or person.

Table 7. Hazard log table.

Date	Hazard No.	Hazard	Location	Potential Consequences	Risk Rating Prior to Control Measures	Expected Risk Rating After Control Measures	Responsibility for Action	Review Date	Closed Out Date

Table 8. Common airport hazards.

A - Hazard Category	B - Main Components	C - Potential Consequences
Jet blast	Operating aircraft jet engines	• Blowing over vehicles, equipment, objects, particularly in the ramp area • Displacing people, particularly in the ramp area
FOD	FOD management, maintenance and construction activities, airside activities, pavement deterioration, aircraft operations and maintenance	• Jet blast of FOD striking people, aircraft, equipment, or infrastructure • FOD being ingested into the engines of operating aircraft • FOD damaging the aircraft during operations (e.g., accident with Concord aircraft)
Runway usage	ATC, aircraft, vehicles	• Runway incursions • Insufficient runway distance available for landing or taking off • Wrong runway usage • Aircraft undershoots and runway excursions • Lack of or misleading Notices to Airmen (NOTAMs)
Taxiway routings	Traffic control, weather conditions, communication, markings	• Routing errors with aircraft and vehicle collisions • Runway incursions • Low visibility • Incorrect phraseology • Human errors • Deficient marking and signing
Airside ground traffic	Traffic control, visibility and adverse weather conditions, communications, equipment maintenance	• Vehicles and aircraft running over people • Collisions in the non-movement areas • Runway incursions and collision with aircraft • Speeding of ground vehicles • Poor equipment maintenance and malfunctions • Human errors • Incorrect phraseology
Winter services procedures (de-icing, anti-icing and snow removal)	Procedures, equipment, training, materials, poor operation conditions, timing, monitoring of surface conditions, reporting of surface conditions	• Lack or incorrect de-icing procedures may disable aircraft ability to fly • Improper snow removal or anti-icing may lead to improper braking capability on the runway with risk of overruns and veer-offs • Asymmetric drag during operations may cause veer-offs • Poor braking performance causing collisions in movement and non-movement areas • Lack of sufficient materials • Equipment coordination disruption • Delay to employ safety measures • Low runway friction • Pilot unawareness of surface conditions
Rescue and fire fighting	Deficient ARFF facilities and equipment, lack of appropriate access routes, poor planning and training, lack of appropriate materials and protective equipment, poor maintenance, poor emergency awareness	• Improper training can delay rescue and firefighting • Lack of appropriate access routes may delay operations • Inoperative equipment can restrict ARFF capabilities • Insufficient equipment and materials can restrict capability • Poor equipment maintenance may jeopardize effectiveness • Improper protective equipment may restrict rescue and firefighting operations • Level of protection lower than that required will restrict capability during major accidents • Lack of water rescue capability at airports close to great stretches of water or swampy areas will restrict rescue capabilities • Inappropriate facilities that provide for rest, exercise, drill, training, etc. will pose restriction to staff working at the fire station • Delay to initiate operations will restrict occupant survivability • Poor communications procedures and equipment readiness will restrict ARFF capability

Table 8. (Continued).

A - Hazard Category	B - Main Components	C - Potential Consequences
Crisis and contingency management (medical, disabled aircraft removal, etc.)	Planning and training, coordination, communications, equipment, procedures, command	• Delay to respond to emergencies and decrease in survivability • Delay to isolate the accident area • Delay to remove accident obstacles • Delay to inform other pilots and operators • Lack of coordination • Incorrect phraseology • Lack of appropriate equipment and procedures • Poor alerting services • Dated contact information • Loss of operational control • Unavailable resources • Command structure decay and delay
Special events (air shows, etc.)	Coordination, security, procedures for non-standard operations, spectator proximity to aircraft and operations, spectator unawareness of risks, communication, FOD, marking and barricading of restricted areas, new ignition sources	• Damage to aircraft • Loss of aircraft control during maneuvers • Runway incursions • FOD and jet blast consequences • Collisions • Damage to equipment • Fire • Vandalism • Poor event performance • Loss of public relations opportunity • Other vehicle, aircraft, staff, and spectator accidents
Adverse environmental conditions (night, low visibility, adverse wind conditions, precipitation)	Training and experience for adverse weather conditions, preparation and communication, visibility and lighting conditions, runway surface conditions, approach conditions	• Visual aid and electronic device malfunction or destruction • Aircraft and ground vehicle collisions • Increased aerial and surface condition hazards • Aircraft and vehicles running over airport workers and passengers • Aircraft overruns, veer-offs, and undershoots • Reduced emergency response capability
Airport development, construction, and maintenance activities	Impact of construction on operations, impact of operations on construction, coordination (air traffic, apron management, security, etc.), access routing, communication (e.g., NOTAMs), FOD and dust control, construction signage, temporary airfield signage, interference with operations and NAVAIDS, off-peak construction, construction worker training and awareness, safety and emergency plans, construction quality, construction equipment maintenance, construction OSH compliance, location of existing installations	• Breakdown of construction equipment • Jet blast affecting construction area • FOD • Runway incursions • Malfunction of NAVAIDS • Damage to aircraft • Pilots, ATC, airport workers, and contractor unaware of construction and changed operation conditions • Accidental interference with existing installations • Equipment, stockpile, and construction location within airfield safety areas • Material stockpiles or construction equipment obstructing the view of ATC • Permitted times for construction not strictly followed • Displacement of construction equipment and materials by prop wash, jet blast, or wind • Edge and threshold lights for closed portions of a runway not properly disconnected or covered to prevent pilots use of the areas
Wildlife hazards (birds and other wildlife)	Fencing, wildlife detection systems and procedures, deterrent devices, wildlife management plan, training and equipment for wildlife control, minimization of attractants (through disposal of food and airport trash, garbage receptacles, and airport zoning)	• Bird and wildlife strikes to aircraft and vehicles • Loss of aircraft and vehicle control • Improper use of wildlife deterrent devices • Damage to perimeter fences • Poor field monitoring and reporting • Poor wildlife control
Security issues	Access control	• Runway incursions • Vandalism • Terrorism

(continued on next page)

Table 8. (Continued).

A - Hazard Category	B - Main Components	C - Potential Consequences
Visual and non-visual aids for approach and landing	Adequacy and reliability, interference, runway approach area updates	• Inaccurate approach and landing • Unavailability of NAVAIDS • Collision with obstacles • Aircraft overruns and undershoots
Inspection and survey activities (internal and external)	Frequency, personnel training, equipment	• Failure to identify and report existing hazards • Runway incursions • Failure in communication procedures • Use of incorrect phraseology • Equipment malfunction
Protection of NAVAIDS and related sites	Fencing, vigilance, maintenance, zoning, signage	• Inoperative or damaged equipment • Interference to NAVAIDS from new developments in the area • Aircraft collisions • Failure to ensure a secure and safe area • Airport closure
Obstacles	Signage, monitoring, awareness of pilots, and ATC	• Aircraft collision with obstacles • Vehicle and equipment collisions • Presence of unreported obstacles • Change in obstacle condition • Inaccurate location and elevation of obstacle
Fuel handling	Operating procedures, spillage control procedures, proximity of ignition sources, supervision and training, equipment compatibility, fuel storage	• Spillage • Misuse • Fire • Contamination • Damage to asphalt pavements • Environmental impacts • Improper handling and spillage control • Procedural violations • Vapor inhalation and ingestion • Downtime of resources
Hazardous materials handling	Handling procedures, spillage control procedures, supervision and training, storage	• Spillage • Environmental impacts • Damage to equipment • Improper handling and spillage control • Procedural violations • Human injuries • Downtime periods • Airport closure
Passenger handling	Handling and control procedures, supervision, monitoring, operation of passenger bridges, operation of buses, evacuation procedures	• Vehicles striking passengers • Slips and trips • Unawareness of airport dangers • Inadvertent or deliberate damage to aircraft and equipment • Improper use of safe routes • Running aircraft engines • Speeding of passenger buses • Passenger deviating from their designated routes
Communications	Communication procedures, equipment maintenance, training	• Miscommunication • Incorrect use of communication devices • Incorrect phraseology • Impact on operations and emergency services • Equipment failure • Loss of coordination and control • Operator error • Loss of airport operations capabilities
Airport reporting (Airport Publication Information [AIP], NOTAMs, etc.)	Responsibility, up-to-date information	• Improper notification and update procedures • Delay in operations • Change in conditions • Failure to publish NOTAM • Runway incursions • Collisions

Table 8. (Continued).

A - Hazard Category	B - Main Components	C - Potential Consequences
Apron management	Airport rules and regulations, SOPs, access control, gate assignment, ramp congestion, turnaround times, airport infrastructure, technology available, and maintenance	• Aircraft assigned to incorrect gate • Collision between aircraft and vehicles • Inadequate lighting, glare, or confusing lights • Non-enforcement of rules, regulations, and SOPs • Lack of centralized and uniform management • Poor, misleading or non-standard markings • Poor supervision of ramp activities • Deficient coordination with ATC, tenants, and service providers • Low capacity of infrastructure • Malfunction of ground control equipment • Aircraft stands are not serviceable, clean, or free of obstructions • Passenger bridge not retracted or correctly parked • Non-availability of emergency equipment • Lack of functional check of the passenger bridge before utilization • Improper use of apron real estate and reduced capability • Delay of operations
Ground operations (marshalling, catering, towing, baggage handling, apron bridges, etc.)	Airport rules and regulations, equipment parking, SOPs, supervision, pilot blind area, personal protection equipment (PPE), training, self-maneuvering operations	• Propeller blades striking people or equipment • Jet blast displacing materials and equipment, and striking people • People and objects being sucked by jet engine intakes • Unsafe aircraft towing • Pilot cannot perceive presence of equipment and/or people • Vehicles striking aircraft and/or people • Falls and falling objects • Inappropriate aircraft chocking • Activities start before aircraft engine shuts down • Hot aircraft brakes • Untrained aircraft Marshaller • Use of non-standard marshalling signals • Improper passenger bridge operation • Lack of emergency stop procedures • Improper parking location by vehicles and aircraft
Training and licensing	Competency training and evaluation, access requirements for movement, non-movement areas	• Poor training • Non-qualified workers performing activities at the ramp • Violations of rules and regulations • Failure to perform duties • Incorrect execution of procedures
Infrastructure, pavements (FOD, runway friction, roughness, pavement condition) Safety areas Markings Signs Lighting Electrical systems Engineered Materials Arresting Systems (EMAS)	Pavement management, marking, and lighting, aircraft arresting systems	• Deteriorated pavement • FOD • Inappropriate Pavement Condition Number (PCN) • Poor runway surface friction condition, contaminated surface (rubber build-up, ponding, ice, snow, dirt), ungrooved pavement • Uneven or non-smooth pavement may damage aircraft equipment • Bumps, potholes, rutting • Excessive difference in elevation between adjacent areas • Malfunction of lighting system • Missing, unclear, or deteriorated markings • Lack of maintenance of aircraft arresting systems
Occupational health and safety	Equipment, procedures	• Improper procedures • Lack of PPE
Helicopter operations	Segregation, location, and type of operations	• Helicopter blades striking people, vehicles, and equipment • Rotor wash displacing objects
Equipment maintenance and conditions	Airport ground equipment, visual aids, NAVAIDS, surface movement guidance and control	• Disruption of operations • Runway incursions • Runway excursions and undershoots • Collisions • Aircraft and vehicles striking people

(continued on next page)

Table 8. (Continued).

A - Hazard Category	B - Main Components	C - Potential Consequences
Shift work	Effects on health, coordination, timing	• Fatigue • Lack of concentration • Human errors • Poor duty performance
Change in conditions	New equipment, new aircraft, new employee, new regulation, new SOP, new or withdrawal of services, new tenant	• Deficient risk assessment for new conditions • Deficient infrastructure to effect change • Untrained workers on new procedures • Employees unfamiliar with new workplace • Lack of coordination between services
Landside hazards	Landside traffic, parking, pedestrian crossings	• Vehicle collisions • Vehicles striking pedestrians • Accidents in parking areas
Passenger terminal hazards	Maintenance activities, electric carts (at larger terminals), airport equipment, people movers, escalators, elevators, spillages	• Slips, trips, and falls • Carts striking pedestrians • Hands, feet, clothing, or shoes that become entrapped in the escalator or people mover • Injuries caused by sudden stops, misleveling, and mechanical malfunctions of elevators

Using Figure 8, you can determine some risks associated with the construction activity. Focus on one of the hazards described in the previous example: jet blast from aircraft accelerating for takeoff. When taking off, many pilots start to accelerate the aircraft while it is still in the taxiway, just before aligning with the runway. In such a case, the jet blast can be aimed at the construction area, as shown in Figure 9. The blast can displace equipment and debris, and people may get hurt.

5.5 Assess and Analyze Risk

Risk assessment is the process that associates "hazards" with "risks." The process involves both estimating and classifying risks. The simplest way to estimate the risk associated with a specific hazard is to ask the following two questions:

1. What possible harm could the hazard present (the consequences)?
2. How likely is it that harm could occur (the likelihood)?

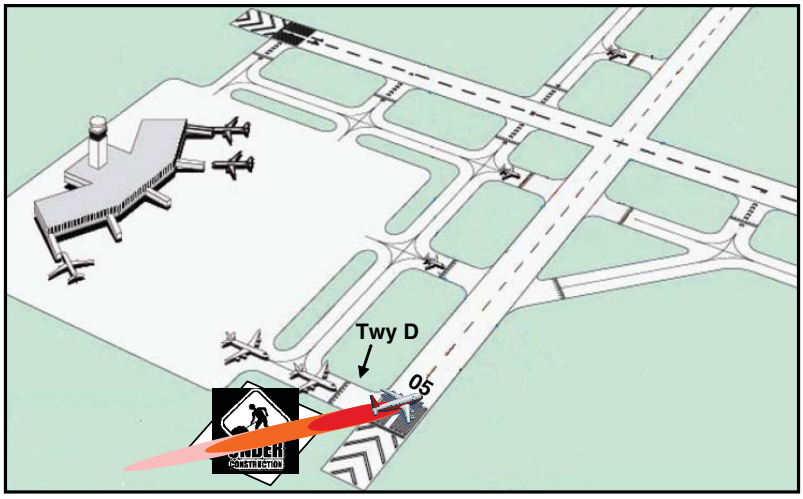


Figure 9. Jet blast in construction area.

A risk assessment needs to address both answers to obtain a clear picture of what controls to take. For instance, the consequence may be minor but the likelihood may be high. Therefore, properly controlling the likelihood should be a higher priority.

After you estimate the consequences and the likelihood, you can use this information to classify your risk. Risk classification is necessary to identify how serious risks are and to define the order in which they should be treated, particularly if you don't have all the resources needed to take every mitigation action in the short term.

Estimating Risks

To estimate the two risk components you may use the following guidelines:

Consequences. Determine the severity of the hazard in terms of its potential impact on the people, equipment, or activity. Cause and effect diagrams, scenarios and "What-If" analysis (see Annex E) are some of the best tools for assessing the risk severity. Severity assessment should be based on the worst possible outcome that can reasonably be expected. Severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel error, environmental conditions; design inadequacies; procedural deficiencies; or system, subsystem, or component failure or malfunction. To estimate the consequences, you should always consider the "worst credible scenario" to avoid underestimating the risk and thereby applying inaccurate controls. For instance, the worst credible consequence for an air carrier aircraft undershooting a runway would be multiple fatalities and significant property damage.

Likelihood. Determine the probability that the hazard will cause an accident or incident of the severity assessed previously. Probability may be determined quantitatively, when a method or historical information is available. Assigning a quantitative mishap probability to a new activity or system may not be possible early in the planning process. A qualitative probability may be derived from research, analysis, and evaluation of historical safety data from similar activities and systems. Supporting rationale for assigning a probability should be documented for future reference.

Some possible means to estimate the likelihood of an accident are the following:

- Using historical data on similar accidents and incidents, if the information is available
- When historical data for the airport are not available, check if information is obtainable for airports with similar characteristics
- When no information is available on accident/incident rates associated with the hazard, check what frequency of accidents/incidents is caused by equipment, operations, or procedures with similar characteristics at other airports.

An airport with restricted runway safety areas (RSAs) is a good example of how to estimate the likelihood of occurrence of undesirable events. An airport with restrictions in terms of RSA may not have faced any aircraft overruns, but this does not mean that an overrun could not occur. In this case, the team assessing the risk may examine data from NTSB and FAA and confirm there is a considerable amount of useful data to draw some conclusions regarding the probability of an overrun. In some circumstances, this approach will also help to estimate a credible severity level for the specific risk.

An effective way to estimate risk, particularly when no historical data is available, is to gather a group that has expertise in the relevant areas to independently rate the risk. A follow-up discussion, eventually using the average level of the group to rate the risk, is a practical and solid way to perform this task. The group may be formed by members of an airport safety committee or, when feasible, experts can be brought in from other organizations.

Classifying Risks

The second aspect of risk assessment is the ranking of risks into a priority order. The most common tool used for risk classification is the risk matrix. The risk matrix is a simple but powerful risk assessment tool for most airport hazards. Those performing the risk assessment should use the risk score in conjunction with good judgment, understanding, and awareness of the risk.

The most important risk is the one with the greatest potential impact on airport activities, although even the least important risk may deserve some attention and possible risk control action. You should keep in mind that this priority listing is created as a guide to the relative priority of the risks involved and is not intended to be an absolute order to be followed. There are low priority risks that are extremely simple to control and appropriate actions should be taken. For example, a burned out light bulb on the runway can and should be replaced quickly and easily, even though the risk associated with it is low.

A realistic and effective risk assessment should involve an expert or group of experts. Typically, the best experts are those who are most familiar with the hazard; in most cases, this is the line worker. For some hazards, however, the risks cannot be known simply through the process of familiarity. Such is the case with hazardous substances and confined spaces. For these hazards, other expertise is required. In most cases, such expertise can be gained from regulations, standards, manufacturer instructions, competent training organizations and safety consultants, material safety data sheets, and so on.

The initial risk assessment should consider the existing risk controls. Each time a risk control is added, the person performing the assessment should re-assess the risk until it has been reduced to a level as low as reasonably practicable (otherwise known as ALARP).

For the example depicted in Figure 9, the severity is rated as high because construction workers can be killed if heavy equipment is displaced and strikes them or if they are thrown by the jet blast. The probability in this case is also high, particularly in a busy airport, when the taxiway is used many times every day.

About the Risk Matrix

The risk matrix is a simple table divided into columns and rows. The rows are used to represent values of probability or likelihood, and the columns are used to represent values of consequence. Where the columns and rows intersect is the assessed value of risk.

The risk matrix forms the basis for judging both the tolerability of a risk and the management level at which the decision on tolerability will be made. The matrix may also be used to prioritize resources to resolve risks resulting from hazards or to standardize hazard notification or response actions. Severity, probability, and risk assessment should be documented to serve as a record of the analysis for future use. Existing databases, the risk matrix, or a panel of personnel experienced with the mission and hazards can be used to help complete the risk assessment.

A risk matrix usually has three to five columns and three to five rows. Each column represents a different level of consequence, and each row represents a different level of likelihood. Each cell is a combination of consequence and severity and represents the risk level. Usually the cells have colors or criteria for risk acceptance. The risk matrix depicted in FAA AC 150/5200-37 has five consequence levels, five likelihood levels, and three overall risk levels represented by colors: red for high risk, yellow for medium risk, and green for low risk, defined as follows (see Figure 10):

- High—the risk is unacceptable and the activity should be discontinued until the risk is mitigated.
- Medium—the risk is acceptable; action may be implemented or the activity can continue with control and tracking measures.
- Low—the risk is acceptable without restrictions.

Risk Matrix

RISK MATRIX		SEVERITY				
		No Safety Effect (A)	Minor (B)	Major (C)	Hazardous (D)	Catastrophic (E)
LIKELIHOOD	Frequent (5)	LOW	MEDIUM	HIGH	HIGH	HIGH
	Probable (4)	LOW	MEDIUM	HIGH	HIGH	HIGH
	Remote (3)	LOW	LOW	MEDIUM	HIGH	HIGH
	Extremely Remote (2)	LOW	LOW	LOW	MEDIUM	HIGH
	Extremely Improbable (1)	LOW	LOW	LOW	LOW	HIGH / MEDIUM

High Risk
Medium Risk
Low Risk

Figure 10. Risk matrix. [1]

Note that in this guidebook, the colors have been replaced with shading. The darkest shading represents high risk, the medium shading represents medium risk, and the lightest shading represents low risk.

> "At U.S. airports, many of the airport operators' actions are governed by standards issued by the FAA. The FAA would not expect an airport operator to conduct an independent risk analysis of an action or condition directed by a mandatory FAA standard or specification. Any discretionary action or decision by the airport operator in the application of the standards should still be analyzed." [1]

You can select a risk matrix that best fits your airport's needs. Some guidelines on building your own risk matrix are provided in the next section.

Building Your Risk Matrix

Risk matrices are easy to use; however, they must be designed properly to avoid a false sense of safety. Your risk matrix should have the following characteristics to be effective:

- Fit your airport's needs (size and complexity)
- Be simple and easy to use and understand
- Not require extensive knowledge of quantitative risk analysis
- Have consistent likelihood ranges that cover the full spectrum of potential scenarios
- Have detailed descriptions of the consequences of concern for each consequence range
- Have clearly defined acceptable and non-acceptable risk levels

There are two key decisions to be made when designing your risk matrix:

1. Defining how many columns (levels of severity) and rows (levels of likelihood) you need. For smaller airports, it may be preferable to use a simple risk matrix with three levels of consequence and three levels of likelihood. These airports have fewer hazards and limited staff to perform risk assessments. Larger airports may wish to have an expanded risk matrix that will avoid classifying too many hazards in the same category.

2. Defining risk tolerability criteria. Your airport should avoid developing a risk matrix that implies a level of risk tolerability that is too generous and does not translate into what your airport actually desires. For most risk matrices there are three or four different levels of risk tolerability; however, some organizations use up to six different tolerability levels to facilitate the definition of control actions when using software management tools. Note that it is recommended to seek legal counsel when defining your risk tolerability criteria as it may impact a law that may be applicable to your airport.

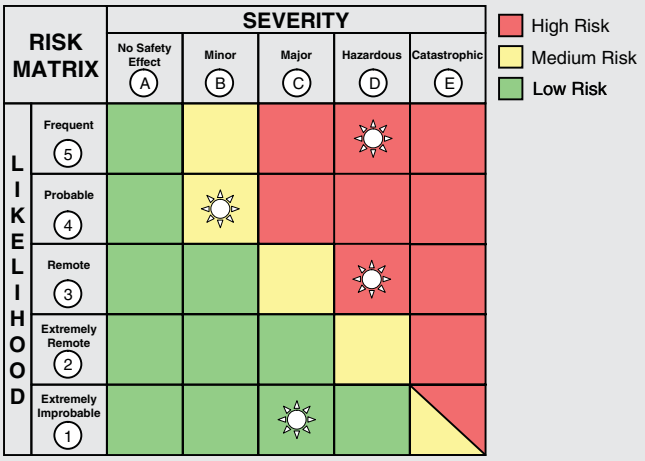
Another key aspect of risk matrix design is having the capability to evaluate the effectiveness of risk mitigation measures. The risk matrix should always allow the risk ranking for a scenario to move to a risk tolerable level after implementation of mitigating measures. Otherwise, it may be difficult to determine the effectiveness of mitigation measures.

Some organizations also include rankings or priorities for each cell. In general, the higher the number in the cell, the higher is the priority to mitigate the risk.

The next section describes some criteria that may be used for risk classification. In this case, the risk matrix depicted in FAA AC 150/5200-37[1] was used. Simpler matrices and criteria can be used based on the information presented.

A sample risk matrix is depicted below. Risks are ranked according to the severity and the likelihood. Hazards with high risk receive higher priority for treatment and mitigation.

Risk Matrix



Risk Classification

Having a risk matrix is usually not sufficient for risk classification. The risk matrix works better if you assign specific quantitative and qualitative criteria to risks. Stating that a credible consequence is minor, for example, is very subjective. Another person assessing the same risk may find the consequence is major. It will be easier for both to agree if you define criteria for minor and major consequences. For example, you may describe a minor consequence as a "physical discomfort to people" and major consequence as "physical distress, possibly including injuries."

Table 9. Risk severity classification.

Criteria	Risk Severity Classification				
	No Safety Effect A	Minor B	Major C	Hazardous D	Catastrophic E
Effect on aircraft operations	No effect on safety	Slight reduction in safety margin or functional capabilities	Significant reduction in safety margin or functional capability	Large reduction in safety margin or functional capabilities	Hull loss
Effect on people	Inconven-ience	Physical discomfort	Physical distress possibly including injuries	Serious or fatal injury to small number of people	Multiple fatalities
Effect on airport reputation	Slight to moderate impact	Loss of community reputation	Loss of state reputation	Loss of national reputation	Loss of international reputation
Financial loss	Slight damage is less than $10,000	Noticeable damage between $10,000 and $100,000	Large damage between $100,000 and $1,000,000	Major damage between $1,000,000 and $10,000,000	Severe damage exceeds $10,000,000

Each airport may establish its own risk criteria for both consequence and likelihood. An example of such criteria is described in Tables 9 and 10 for the risk matrix depicted in Figure 10. The criteria suggested are based on the FAA Air Traffic Organization Safety Management System Manual applicable to ATC and navigation services in the National Airspace System (NAS). The impacts on the airport's reputation and financial loss were added to those criteria. So far, there are no regulatory safety level requirements or criteria for airports; each airport must establish its own.

Records of the risk assessment process and results must be kept, including the name of the person(s) performing the risk assessment. The results of the risk assessment should be used to help identify appropriate control measures for the elimination or reduction of the risk to an acceptable level.

Table 10. Risk likelihood classification.

Criteria	Risk Likelihood Classification				
	Extremely Improbable 1	Extremely Remote 2	Remote 3	Probable 4	Frequent 5
Quantitative (# of ops for 1 event)	More than 1,000,000,000	Between 10,000,000 and 1,000,000,000	Between 100,000 and 10,000,000	Between 1,000 and 100,000	Less than 1000
Qualitative	Less than once in 100 years	Once every 10-100 years	Once every 1-10 years	Once every month	More than once every week

5.6 Treat and Monitor Risk

This process should include a follow-up risk assessment to ensure that no new hazards are introduced by the selected mitigation control.

Looking for Alternatives

Risk treatment alternatives should address the risk probability, the risk severity, or both. The following examples were classified according to one of the categories, either reducing likelihood or reducing consequences; however, in most cases the effect is on both the likelihood and the severity simultaneously.

- Reducing Likelihood
  - Implement the airport SMS
  - Raise awareness and/or control (e.g., safety campaigns, NOTAMs, briefings, enforce airport rules)
  - Provide training (e.g., on-the-job training, recurrent training on SOPs, improve skills)
  - Establishing procedures (e.g., avoid operations under certain conditions, develop or modify SOPs, intensify frequency of sweeping areas subject to FOD)
  - Avoid the risk by ceasing the activity (e.g., close taxiway for operations during maintenance activities)
  - Increase supervision (e.g., escorting non-airport workers, monitor ramp activities, intensify inspections)
  - Improve infrastructure and equipment (e.g., install a surface movement guidance and control system (SMGCS), improve signage, use magnetic bars and FOD containers)
- Reducing Severity
  - Improve emergency response (e.g., reduce emergency response time, improve coordination and capability)
  - Improve infrastructure (e.g., extend runway safety areas, remove obstacles, cover drainage ditches)
  - Establish SOPs (e.g., define procedures for strong wind conditions)
  - Create special programs (e.g., wildlife programs to avoid presence of large birds, establish rules for reduced speed at the ramp)

Going back to the example depicted in Figure 9 for the jet blast hazard, airport operations evaluated two alternatives for treating the risk:

1. Close the taxiway to aircraft operations
2. Issue a NOTAM and request ATC to caution aircraft pilots to use idle power when entering the runway

Option 1 was selected because there was no guarantee the pilots would remember the ATC and NOTAM requests. It is important to note that this option may require a formal process to obtain FAA authorization and close the taxiway.

When possible, select and appoint a group of staff (task group or work group) who are knowledgeable on the airport sector or activity that you are targeting (i.e., where the hazard associated to the risk in question is located, be it maintenance, operations, etc.), to identify possible risk mitigation strategies. This is an ad hoc group assigned to evaluate a specific hazard associated with the activities with which this group is familiar. For example, if the hazard is related to emergency operations, the ARFF staff is probably the best group to identify mitigation controls because that is the activity with which they are most familiar.

Risk Mitigation Strategies

The ultimate purpose of hazard identification, risk determination, and analysis is to prepare for risk mitigation. Risk mitigation measures may work through reducing the probability of occurrence, the severity of the consequences, or both. This section discusses the importance of risk mitigation planning and describes approaches to mitigating safety risks.

Some risks, once identified, can be eliminated or reduced readily, particularly those found during the daily self-inspections. However, other risks are much more difficult to mitigate, particularly high-impact, low-probability risks. Therefore, risk mitigation and control actions may require long-term efforts by the airport.

When developing risk mitigating strategies, be careful with solutions that are based on human performance; this is the least reliable sort of "solution."

The identification of appropriate risk mitigation measures requires a good understanding of why the hazard is likely to manifest and the factors contributing to the probability and/or the severity of its consequences. Achieving the desired level of risk reduction may require the implementation of more than one mitigation measure.

The risk mitigation approach selected may include avoidance, transfer, assumption, or control.

Risk Avoidance. prevent the occurrence by selecting a different approach or by not participating in the operation, procedure, or system development. For example, when rehabilitating a runway, the airport can avoid many construction risks by closing the runway; however, if the airport has only one runway, the best option may be to go with off-peak construction and close the runway during certain periods of the day. An avoidance strategy is one that involves all the stakeholders associated with the proposed change. Ceasing operations is always an avoidance alternative when timely mitigation actions are not available for unacceptable risks.

Risk Transfer. shift the ownership of risk to another party. One transfers risk primarily to assign ownership to the organization or operation most capable of managing it. The receiving party must accept the risk, which should be documented (e.g., via a Letter of Agreement). Examples of risk transfer in airport activities may include

- Issuing NOTAMs to warn pilots on hazardous conditions (e.g., low runway skid resistance). In this case the airport leaves the pilot to judge if the operation is safe.
- Transferring safety management of ramp areas to airlines exclusively using those areas of the airport.

While transfer of risk is theoretically an acceptable means of dealing with risk, it cannot be the only method of mitigation used to treat high risk associated with a hazard. The stakeholder must still mitigate the safety risk to medium or low before it can be accepted. Moreover, when identified hazards (and their corresponding risks) are outside the scope of the SMS (e.g., OSHA, physical, and information security), you should transfer the management and mitigation of these risks to the appropriate airport organizational unit.

Risk Assumption. accepting the likelihood or probability and the consequences associated with a risk's occurrence. When a risk is classified under an acceptable level, you are assuming that it is low enough that no mitigation action is required in the short term.

Risk Control. options and alternative actions that lower or eliminate the risk. Examples include implementing additional policies or procedures, improving the airport infrastructure, developing redundant systems and/or components, and improving training. A control is anything that reduces the risk associated with a hazard. Controls can be complex or simple. It is important that they are effective and verified before the change is approved for operation. It is essential that each risk mitigation control is monitored for unintended consequences when put into place.

When planning how hazards are to be controlled and risks reduced, the following hierarchy should be considered:

- Elimination—can the hazard be eliminated completely? (e.g., removing an existing obstacle)
- Substitution—can the activity or operation be substituted for a lower risk alternative? (e.g., using air bridges or buses to transfer passengers, rather than have passengers walk on the apron)
- Engineering Controls—is there a technical solution? (e.g., runway incursion prevention system [RIPS])
- Procedural Controls—can procedures be developed? (e.g., SOPs, training, limiting exposure to hazardous operation conditions)

Controls closer to the top of the hierarchy are preferable because they are less dependent on human behavior. Elimination of hazards is the first choice in controlling risks, but when this is not practical, isolation and engineering controls should be considered. Administrative controls and PPE may provide interim solutions in a planned program to eliminate or reduce a particular risk, or they may be useful in addition to other control methods. In many circumstances, control solutions will incorporate a combination of controls.

5.7 Example of SRM

The example of SRM described in this chapter includes the analysis process for a list of five typical airport hazards. The SRM involves five steps: describe the activity or system, identify hazards, determine the risk, assess and analyze the risk, and prioritize and treat the risk.

Step 1—Describe the System or Activity

Defining and bounding the system or subsystem will help you focus on a specific activity that will assist with having a better assessment of hazards involved with that activity. For example, let's assume the airport will have a new aircraft operating next year. The aircraft is larger than the ones currently operating at the airport. The activity (or system) in this case is "the operation of a new aircraft."

In a proactive risk management setting, system (or activity) identification is performed before the hazard identification step. However, in many cases, the identification of a hazard might take place even before the system is identified and lead to an activity (or system) that is the source. As an example, in a daily inspection of the airport airside, the airport on-duty operations officer found some FOD on the runway. The existence of FOD on the runway is a hazard. The system in this case is the whole airside, and the activity causing the hazard may be the construction work

Table 11. Hazard identification in the airport system.

Hazard #	System	Subsystem	Activity	Description of Hazard	How Hazard Was Identified
1	Airside	Movement Area	Runway operations	Runway rubber build-up	Pilot reports and runway friction measurements
2	Airside	Construction Site	Construction - drainage pipe replacement near runway threshold	FOD	Pre-construction conference
3	Airside	Non-Movement Area	Ground traffic in ramp area	Speeding in ramp area	Increase in speeding violations from trend analysis
4	Airside	Movement Area	Topographic survey for runway rehabilitation	People crossing movement areas	Manager's meeting
5	Airside	Gate Areas	Aircraft services in gate areas	People approaching aircraft before anti-collision light is turned off	Daily inspections at the ramp

taking place in the vicinity of the runway. Table 11 contains additional examples of hazards and their associated activities.

Step 2—Identify the Hazards for the Activity

Once the system, subsystems, or activities are defined, the hazards should be identified. Each activity might incur one or more hazards. For the example of a new large aircraft, some brainstorming questions leading to the identification of hazards may include

- Is the current ARFF capacity compatible with the new aircraft?
- Are current taxiway and ramp markings appropriate to the new aircraft?
- Does the pavement structure of areas used by the new aircraft have sufficient capacity to handle the new loads?
- Are runway and taxiway width and safety areas compatible with the standards for the new aircraft?
- Is there enough room at the ramp and gate area to accommodate the new aircraft?
- Is the AEP compatible with the operation of the new aircraft?
- Is current training for airport workers compatible with the new operation?

Answers to these questions will indicate potential hazards linked to such a change in operation.

As a general example for the SRM process, five hazards were assumed in an airside system, as presented in Table 11. The subsystems related to each hazard are also described to facilitate the understanding of the SRM process.

A hazard is not a danger by itself. It is always associated with certain conditions that have the potential to result in an accident:

- A 15-knot wind can be a hazard if it is blowing across the runway; however, if it is aligned with the runway, it can actually reduce the runway length needed for landing
- Rubber built up on the runway is only a hazard when it reduces skid resistance if the surface is wet

Step 3—Determine the Risk

Once you know the hazard, ask yourself what could go wrong. To determine the risk, you should look at all the possibilities, even those that seem to have little chance of occurrence. Table 12 presents the associated risk scenarios for the hazards identified in the previous step. As shown, the presence of FOD may cause damage to aircraft engines if it is sucked in or may cause damage to equipment and people if it is displaced by jet or propeller blast.

Step 4—Assess and Analyze the Risk

Risk is assessed by evaluating the likelihood (probability) of the occurrence of each risk scenario and the severity of the consequences of those scenarios. For each risk scenario, there may be several levels of consequences. If so, you should take the worst credible consequence as the reference for your assessment.

As shown in the risk matrix in Figure 11, the likelihood varies from extremely improbable to frequent and the severity varies from no safety effect to catastrophic. The shading of the cells in the matrix represents the risk level (i.e., darkest shading is High Risk, medium shading is Medium Risk, lightest shading is Low Risk).

For runway rubber build-up (hazard #1), the worst credible consequence is that the pilot may not be able to control the aircraft during landing. The aircraft will depart the runway at high

Table 12. Risk determination for identified hazards.

Hazard #	Description of Hazard	Risk Scenarios
1	Runway rubber build-up	(a) Aircraft losing directional control and/or braking capability and departing the runway during operation (overruns and veer-offs)
2	FOD	(a) Debris being ingested by aircraft engines (b) Jet or propeller blast displacing debris, equipment, and people
3	Speeding in ramp area	(a) Vehicles striking aircraft, other vehicles and equipment, or people
4	People crossing movement areas	(a) Runway incursions (b) Jet or propeller blasts displacing equipment or people
5	People approaching aircraft before anti-collision light is turned off	(a) People affected by engine blast, propeller blades, or engine suction (b) People being struck by moving aircraft

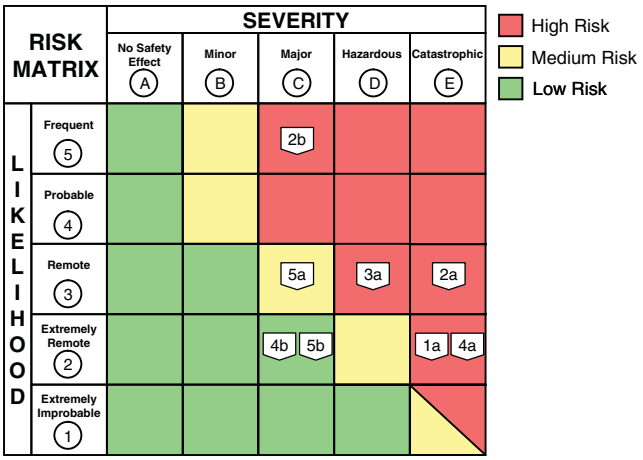


Figure 11. Risks classification using the risk matrix.

speed, running beyond the safety areas and eventually striking an existing structure. In this situation, there is a chance of hull loss and multiple fatalities. The severity in this case can be classified in the risk matrix as Catastrophic (E).

Then you should evaluate the likelihood. Statistics from past overrun and veer-off accidents indicate a chance of 1 catastrophic overrun or veer-off accident in 15 million operations, given the specific airport and hazard conditions (wet runway). Therefore you can classify this risk as Extremely Remote (2).

This hazard, according to the risk of an aircraft departing the runway during a landing operation, is then classified as 2E, which falls in the zone of High Risk (darkest shading). This is labeled as hazard "1a" in Figure 11. The same process can be applied to other hazards and risk scenarios. The results are both marked on the matrix and presented in Table 13.

Table 13. Risk level classification.

Hazard #	Description of Hazard	Risk Description	Likelihood Level	Severity Level	Risk Classification
1	Runway rubber build-up	(a) Aircraft departing runway	2	E	High
2	FOD from construction	(a) FOD ingestion	3	E	High
		(b) Jet blast effects	5	C	High
3	Speeding in ramp area	(a) Accidents at the ramp	3	D	High
4	Survey workers crossing movement areas	(a) Runway incursions	2	E	High
		(b) Jet blast effects	2	C	Low
5	People approaching aircraft before anti-collision light is turned off	(a) Aircraft engine effects	3	C	Medium
		(b) Aircraft striking people	2	C	Low

Step 5—Prioritize and Treat Risk

At this point, all the risks associated with identified hazards have been assessed and classified. The next step is to treat the risks; however, for our example, let's say the airport has limited resources and simply cannot eliminate every existing risk. Therefore, we need to find out how to make the best use of limited resources by prioritizing the risks. It is important to note that all risks classified under an unacceptable level should be brought to acceptable levels using mitigation actions.

From Table 13, we identified five risk scenarios classified as High, one as Medium, and two as Low. High-risk scenarios are treated first. But among the high-risk scenarios, which should be addressed first?

If you compare a 3E risk with a 2E risk, you should treat 3E risk first because, with a similar consequence, the probability is higher for 3E. When comparing 2E and 3D, the latter has a higher probability while the former has higher consequences. In this case, they may be classified in the same priority. Taking this approach, the risk scenarios are prioritized as shown in Table 14.

Following the prioritization, it is necessary to decide the actions to treat the risks. Table 15 provides some alternatives for the examples described.

It should be noted that some actions will mitigate more than one risk, and some actions may mitigate the risk temporarily, as in hazard #1. Removing rubber build-up is a temporary solution because rubber will continue to build up at the runway surface and removal will be necessary from time to time. It is easy to understand the need for continuous risk monitoring, even for treated risks, to ensure their level remains acceptable.

A high risk will require immediate attention from the airport operator. Given the urgency of a solution and the limited resources available, the associated action for a high risk may be sufficient only to mitigate it to a medium level. For example, for more permanent results, it may take months before the airport is able to develop a safety campaign with focus on vehicle speed at the ramp. A more urgent and possible measure is to intensify enforcement of airport rules while the campaign is being developed.

Each hazard identified should be documented and recorded in a hazard log, as described in Table 16. The hazard log should contain a description of each hazard, its consequences, the assessed risk in terms of likelihood and severity, and any required mitigation measures. It should be updated as new hazards are identified and proposals for mitigation are introduced. The log depicted in Table 16 was completed using the examples described in this section.

Table 14. Risk scenarios prioritization.

Hazard #	Description of Hazard	Risk Description	Risk Classification	Priority
1	Runway rubber build-up	(a) Aircraft departing runway	**2E - High**	2
2	FOD from construction	(a) FOD ingestion (b) Jet blast effects	**3E - High** **5C - High**	1 1
3	Speeding in ramp area	(a) Accidents at the ramp	**3D - High**	2
4	Survey workers crossing movement areas	(a) Runway incursions (b) Jet blast effects	**2E - High** **2C - Low**	3 5
5	People approaching aircraft before anti-collision light is turned off	(a) Aircraft engine effects (b) Aircraft striking people	**3C - Medium** **2C - Low**	4 5

Table 15. Risk treatment actions.

Hazard #	Description of Hazard	Risk	Priority	Action to Mitigate Risk	Further Actions (when required)
1	Runway rubber build-up	(a) Aircraft departing runway	2	Remove rubber build-up	Repave and groove
2	FOD from construction	(a) FOD ingestion	1	Clean up and define procedure to eliminate source	Provide training on new procedure to contractor workers
		(b) Jet blast effects	1	Clean up and define procedure to eliminate source	Provide training on new procedure to contractor workers
3	Speeding in ramp area	(a) Accidents at the ramp	2	Enforce and implement safety promotion campaign to address issue	Monitor trends in number of violations and implement system of accumulated points to suspend and revoke airport driver's permit
4	Survey workers crossing movement areas	(a) Runway incursions	3	Provide training to contractor employees	Monitor activities and, if necessary, have an airport escort with the survey crew
		(b) Jet blast effects	5	Only allow survey job on areas closed to operations	None
5	People approaching aircraft before anti-collision light is turned off	(a) Aircraft engine effects	4	Enforce SOP for aircraft arrival and departure	Monitor violations and establish recurrent training program for frequent violators
		(b) Aircraft striking people	5	Enforce SOP for aircraft arrival and departure	Monitor violations and establish recurrent training program for frequent violators

Table 16. Example hazard log table.

Date	Hazard No.	Hazard	Location	Responsible Dept/Person	Potential Consequences	Risk Rating Prior to Mitigation	Action to Mitigate Risk	Expected Risk Rating After Mitigation	Review Date	Closed Out Date
Jul 3 2008	1	Runway Rubber Build-Up (low surface friction)	Runway 08/26	Dept of Engineering (John S.)	Aircraft excursion (overrun, veer-off)	2E- H	Remove rubber build-up	M	Apr 1 2008	Jun 12 2008
Jan 4 2008	2	FOD from construction	Intersection of Taxiway A and C	Dept of Engineering (John S.)	FOD ingestion	3E- H	Clean up and define procedure to eliminate source	L	Jun 29 2008	Aug 1 2008
					Jet blast effects	5C- H	Clean up and define procedure to eliminate source	L	Jun 27 2008	Aug 3 2008
Sep 4 2008	3	Speeding in ramp area	Terminal A	Dept of Public Safety (Scott L.)	Accidents at the ramp	3D- H	Enforce and implement safety promotion campaign to address issue	M	Jul 6 2008	
May 15 2008	4	Survey workers crossing movement areas	Terminal C	Dept of Operation (John C.)	Runway incursions	2E- H	Provide training to contractor employees	M	Jul 7 2008	Aug 31 2008
					Jet blast effects	2C- L	Only allow survey job on areas closed to operations	L		
Jun 21 2008	5	People approaching aircraft before anti-collision light is turned off	Terminal A	Terminal Manager (Lynda F.)	Aircraft engine effects	3C- M	Enforce Standard Operating Procedure for aircraft arrival and departure	L	Aug 11 2008	
					Aircraft striking people	2C- L	Enforce Standard Operating Procedure for aircraft arrival and departure	L		

Note: H, M, and L are high, medium, and low, respectively.

The airport's hazards now have been identified and risks determined, assessed, and treated. The SMS records have been organized, placing all information in the hazard log table. However, remember that we need to keep monitoring those hazards and the mitigation measures to ensure they were implemented and that they are effective to mitigate these risks over time.

CHAPTER 6

SMS Operation

Once the SMS is in place, it needs to be managed; this includes on-going monitoring of system performance, as well as the development and implementation of plans for continuous improvement.

On-going management will ensure that the SMS and associated processes are working to improve the level of safety. This should include setting new objectives, continually running the SMS processes, and developing and implementing a plan for improvement initiatives over a given period (e.g., for the next year).

Use the outputs from other elements of the system to evaluate how your SMS is performing (performance measurement, management review, etc.) Once you have identified opportunities for improvement, develop plans to achieve these improvements.

This chapter was designed to help you with the SMS operation. You will identify the major tasks associated with SMS activities and find out more details about the role of an SMS Manager. Moreover, this chapter contains basic concepts and practical guidance on the following:

- Typical tasks for the SMS operation
- Safety culture and how to promote it
- Useful techniques for safety meetings
- How to establish a safety reporting system
- Techniques for accident and incident investigations
- Procedures for internal safety and SMS assessments
- Guidance for safety performance monitoring
- Basic guidelines to establish an SMS training program

6.1 Major Tasks for the SMS Operation

The SMS Manager will be responsible for running the SMS operation. Depending on the size and complexity of your airport, this person may be a full-time SMS Manager, may or may not have staff to support the SMS activities, or may have additional functions at the airport.

The SMS Manager should guarantee the execution of the tasks indicated in Table 17. (Note that these tasks are related to the four SMS pillars and the respective elements described in Chapter 2.) This list is not exhaustive; however, many of the tasks are simple to execute, particularly at smaller airports.

6.2 Safety Culture and Promotion

Effective safety management requires more than a safety office and safety procedures. The safest organizations have something that is difficult to describe and quantify but, when it is there, it is perceptible and obvious. It is the way that the organization and the people within it

Table 17. Major tasks for SMS operation.

SMS		Tasks to be carried out or coordinated by the SMS Manager
Pillar	**Element**	
Policies and Objectives	Organizational Structure	Be alert to any change in the airport organizational structure and its impact on the SMS structure
		Be sure that all the interfaces among the stakeholder activities work toward the SMS operation
	Documentation	Make sure that all the documentation is managed as required by the SMS
	Coordination of the Emergency Plan	Constantly evaluate the interfaces between AEP, airlines, and ATC emergency plans. Assist with recommendation to improve the AEP.
Safety Risk Management	Hazard Identification	Continuously check the compliance of the procedures for collecting, recording, acting, monitoring and providing feedback on hazards and mitigation actions, considering both reactive and proactive approaches
		Collect, compile, and check the effective use of the mandatory, voluntary, and confidential reporting systems, according to the airport policy
		Create adequate environment for the compliance of the reporting systems
		Continuously improve the reporting systems to make them simple, confidential, accessible, informative, and with rapid feedback
		Collect, organize, and store hazard data and safety reports
		Analyze, consolidate essential data, and provide feedback on hazard reports
	Risk Assessment	Coordinate and carry out risk assessments with multidisciplinary groups, and help delineate risk mitigation strategies
		Be sure that all the activities related to hazard identification, risk assessment, and mitigation processes are developed according to the processes defined in the SMS documentation
	Corrective Actions and Monitoring	Delineate procedures to evaluate the effectiveness of mitigation actions
		Coordinate continuous monitoring of identified hazards and the effectiveness of mitigation actions
	Reporting Systems	Ensure the reporting processes are available and working properly
		Assist the Accountable Executive with making sure the airport complies with the established reporting policy
	Internal Safety Investigations	Coordinate the internal investigations to determine root causes for occurrences or events that are not required to be investigated by organizations outside the airport (e.g., NTSB, FAA)
	Improving SOPs	Constantly analyze available safety information obtained during the SMS operation to determine the need to create or improve SOPs
		Assist with the creation and improvement of SOPs
	Assessing the Impact of Changes	Analyze the need to conduct assessments on the impact of future changes in the airport environment such as construction, introduction of new equipment, introduction of new regulatory requirements and processes, changes in security, reorganization of air traffic control, changes to the airport organization, etc.
		Monitor risk control actions taken
Safety Assurance	Performance Monitoring	Ensure that the airport collects data for all performance indicators defined in the SMS documentation
		Assist and conduct trend analysis for each performance indicator
		Monitor SPI trends and evaluate safety performance to suggest actions
		Identify the hazard(s) behind performance indicator trends that point out safety deficiencies
		Identify and assist identifying appropriate potential performance indicators
	Internal SMS Assessment	Plan and coordinate internal assessments according to the SMS requirements, help prepare checklists, coordinate the organization of the teams
		When necessary, help with the analysis and compilation of the information
		Assist with the Identification of areas that need more attention
		Ensure that every airport department receives a summary of the SMS assessment
		Use safety surveys to check the SMS operation in terms of problem areas or bottlenecks in daily operations, perceptions, and opinions of operational personnel, areas of dissent, or confusion
		Ensure that recommended actions that have been approved are adequately implemented

Table 17. (Continued).

SMS		Tasks to be carried out or coordinated by the SMS Manager
Pillar	Element	
Safety Assurance	Management Review	Ensure that adequate information is provided for the Management Review
		Advise the airport high level administrative personnel before, during, and after the Management Review
		Put in practice the strategic plan for safety improvement developed by the Management Review
		Monitor the strategic plan for safety improvement
Safety Promotion	Training and Education	Ensure that all staff levels receive adequate indoctrination and recurrent training, including airport stakeholders when it is the case
		Identify the areas most in need of additional training
		Identify the necessary resources to meet training needs
		Ensure the SMS training program is implemented
		Assist measuring SMS training effectiveness
	Safety Communication	Develop formal means for safety communication within the SMS environment
		Make sure that employees are involved or consulted in the development and review of policies and procedures implemented to manage risks
		Make sure that safety information is disseminated throughout the organization
		Create processes to assess the effectiveness of safety communication
	Continuous Improvement	Ensure the application of the concepts behind the PDCA (Plan, Do, Check and Act)
		Periodically revise the SMS self-assessment and find out areas where improvement is necessary
		Check all regular, periodic, and planned reviews regarding safety processes and performance
		Monitor the decisions and actions aimed at improving safety to evaluate their effectiveness
Other Tasks		Keep close coordination with the SMS Champion if there is one
		Help the line managers with their safety programs
		Coordination of safety items in meeting agendas
		Participate in the airport safety meetings
		Develop, assist, and coordinate safety promotion initiatives
		Assist with obtaining the necessary resources to carry out mitigation actions, training, and other tasks associated with SMS
		Ensure the necessary resources are allocated to the SMS operation

behave—their **safety culture**[29],[30]. Safety culture is not an isolated SMS pillar or element, but it is an essential feature of any effective SMS and should permeate the whole organization to bind its SMS pillars.

All of the airport SMS pillars and elements contribute toward a strong safety culture. It is not the intent of this section to repeat the discussion of these elements, but instead to focus on specific aspects, features, programs, and activities that are aimed specifically at enhancing safety culture. This section describes what safety culture is and how it can be promoted and enhanced at your airport.

Building a strong safety culture requires key organizational activities that promote a high level of risk awareness on the part of the employees and a sense of personal responsibility for reducing risk. Senior management commitment and demonstrated leadership in promoting safety are essential ingredients in the enhancement of a strong safety culture.

General Concepts and Principles

The safety culture concept comes from decades of research on how accidents happen. Before the 1970s, investigations focused on technological failures, adverse weather conditions, and human errors as root causes of aviation accidents. Eventually, investigators and researchers

began to understand that errors could be triggered by a number of additional factors, such as communications problems, decision-making issues, and lack of effective coordination within the organization. In other words, there are often latent causes of errors that are attributable to the organizational environment and that make individual errors more likely.

Elements of Safety Culture

It is important not to confuse non-punitive with accountability. People must remain accountable for their actions, even in a non-punitive environment.

According to James Reason[31], a safety researcher from the United Kingdom, safety culture has five key characteristics: it is informed, reporting, learning, just, and flexible.

In an **informed culture,** workers understand the hazards and risks involved in their tasks, which are the inherent dangers of their working environment. They also understand how their work may have an impact on the safety of other tasks and of the airport in general. Employees continuously monitor operations to identify new or previously unrecognized hazards.

In a **reporting culture,** employees and other stakeholders are encouraged to report safety concerns. They do so without fear of being punished or ridiculed. When safety concerns are reported, they are analyzed, appropriate action is taken, and feedback is always provided. Note that it is advisable to seek Legal counsel when establishing a reporting system that is intended to be confidential and/or non-punitive, as it needs to be fully compliant with applicable laws.

In a **just culture,** management recognizes that most errors are unintentional and makes an effort to understand and correct the conditions of work that make errors more likely. However, when errors are the result of a blatant disregard of rules, malicious intent or gross negligence, punishment is deliberate and fair. For this to work, airport employees must clearly understand what is punishable and what is not.

In a **flexible culture,** employees do not blindly apply procedures. They are capable of identifying the intent of the procedures and understanding the safety envelope. They are therefore able to adapt to changing situations while respecting the safety goals. They are also effective, with appropriate training, in responding to the introduction of new technologies or equipment.

A **learning culture** is one that is characterized by a questioning attitude aimed at continuous improvement. Employees at all levels constantly ask themselves and each other: "*how could we do this better?*" All employees are encouraged and empowered to develop and apply their own experience and knowledge to enhance airport safety. Lessons from errors and incidents are identified, shared, and learned. This means that lessons identified are analyzed and that, when required, risk control actions are taken. It also means that management keeps personnel updated on safety issues and risk control actions taken.

What Does a Strong Safety Culture Look Like?

Safety culture is difficult to quantify, but the following examples provide an idea of what would be expected in an organization with a strong safety culture compared with a weak safety culture. These are examples only; safety culture characteristics can take several forms depending on the organization. Some typical signs of strong and weak safety cultures are depicted in Table 18.

Table 18. Typical signs of safety culture.

In a strong safety culture	In a weak safety culture
Employees are proactive; they continually identify unsafe situations and make an effort to correct them before they become a real problem.	Employees never question procedures they know to be outdated or recommend new procedures that are safer and more effective.
Employees feel that safety is their responsibility and that they have the power to do something about it.	Employees believe that safety is the responsibility of the supervisors or the safety officers.
There are clear policies and procedures that spell out expectations for safety, and the employees understand and believe in them.	There is a safety policy but most people think it is lip-service and window dressing.
Employees truly understand the risks involved in their work.	Employees accept procedures without really understanding why. They do not understand all the risks.
Proactive risk assessment is an integral part of the way the organization manages business, before incidents or accidents happen.	Risk is only evaluated after something bad has happened.
The behavior of employees reflects what the safety policy proclaims.	Employees and managers say one thing, but their actions reflect a different belief.
Personnel receive feedback on safety issues and safety reports.	Safety issues may be analyzed but employees are never really told what was done to address the issue.
Managers and supervisors promote a questioning attitude regarding safety issues on the part of all employees.	Through their actions and behavior, supervisors and managers let it be known that questioning management decisions is not a good thing.
Safety is an integral part of operations management and line managers are clearly responsible.	Safety is seen as the responsibility of a safety office, and their interventions are often perceived as a nuisance to operations.
Upper management takes an active role in safety activities and promotion.	Senior managers delegate their safety functions to a junior manager. They may show occasional interest, but people know that safety is only important as long as it does not affect operations.
All employees believe that safety does not have to come at the cost of productivity or profit.	Employees really think safety efforts are OK as long as the cost is not too high, or as long as it is not THEIR operation that is affected.
Safety goals are set and all employees work toward their achievement.	There are no detailed safety goals other than very general statements.
Safety is an integral part of the training that all employees receive.	There is no specific training on safety management processes and safety is barely mentioned in the existing training courses.
Errors are understood as unintentional, but willful violations are not tolerated.	Errors are treated unevenly and “suitable punishment” depends on the manager involved.
Employees know and agree on what is acceptable and unacceptable behavior.	The treatment of errors is inconsistent.
The organization takes safety initiatives that go beyond strict regulatory requirements.	The organization waits for the regulator to make a safety requirement mandatory before it commits any effort to new safety initiatives.

How Can You Tell If Your Organization Has a Strong Safety Culture?

Accurately assessing the strength of the safety culture within an airport organization is a difficult task, but it provides invaluable information to senior managers on the need for enhancement. It should be done on a periodic basis.

Safety culture evaluations can be (a) simple and internal or (b) complex and independent. The level of effort depends on the degree of accuracy required and on the desired depth of information.

There are several methods for evaluating safety culture within an organization and a multitude of guides on the subject. Four examples are presented:

- Intuitive method
- Checklist
- Internal survey
- External audit

Intuitive Method

We *know* what the culture of our airport is. We do not always ask ourselves, but if we stop and think, we can easily determine whether our organization has a strong or a weak safety culture. However, this intuitive method is not very objective, especially if we are part of the problem. It also relies on our perception, and if communication within the organization is an issue, our perception obviously will be biased. Nevertheless, asking whether our safety culture is strong or weak and why is a good initiative and demonstrates a willingness to identify and correct weaknesses within the organization.

Checklist Approach

Using a checklist-based approach toward the five key characteristics of a strong safety culture can provide a more objective assessment. Table 19 contains checklist questions for each safety culture element. If you answer "no" to more than one question, or if the answer is not immedi-

Table 19. Checklist approach for safety culture assessment.

Characteristics	Question
Informed	▪ Do employees really understand the risks associated with their job tasks and environment?
Reporting	▪ Do employees report their safety concerns? ▪ Are employees willing and able to talk to management about their safety concerns? ▪ Do I, as a manager, really know what these concerns are? ▪ Do we share safety information throughout our organization?
Just	▪ Do we accept that we should learn from errors, and not be predisposed to punish when mistakes happen? ▪ Are we clear about what constitutes an infraction that deserves some kind of punishment?
Flexible	▪ Do employees apply procedures intelligently (or follow them blindly)?
Learning	▪ Do we really ask ourselves and our employees: "is there a better way of doing what we do, from a safety perspective?"

ately clear, there is room for improvement. You could also use the examples of a strong safety culture provided in Table 18 as a basis for comparison.

Internal Survey

Internal surveys are an excellent tool for measuring the attitude of airport employees toward safety. When properly designed and executed, a survey can provide a quantitative score that relates to the strength of the safety culture in the organization. However, surveys are complex. Responses can be biased by the way the questions are asked. Respondents must feel free to respond accurately, and they must also feel that the questions do not unfairly target them. Asking the right questions is an art best mastered by professionals. For example, the question "Do you feel comfortable sharing safety concerns with management?" puts the respondent on the spot, and the response provided may not accurately reflect reality. A more objective response may be obtained by asking: "Do your co-workers feel comfortable sharing safety concerns with management?" Because of the complexity involved in designing the questionnaire, to get the right and true answers, it is recommended to have professional assistance to develop a survey that provides effective feedback.

Table 20 provides an example of the type of statements that may be submitted in a safety culture survey. It is based on actual surveys conducted in the U.S. and abroad. Using computers facilitates the gathering and analysis of data. However, paper surveys are quite adequate and often are able to target a wider audience.

External Audit

External audits usually are conducted by experts through a combination of questionnaires, interviews, and on-the-job observations. This is the most objective and accurate way of evaluating the strength of an organization's safety culture. Several firms are available to conduct such audits. In some cases, it is possible to solicit the help of like-minded organizations that are known to have a strong safety culture to conduct a comparative evaluation. One of the advantages of this approach is that it fosters the mutual exchange of safety information and healthy competition between like-minded organizations.

Promoting and Enhancing Safety Culture

The question remains: How do I promote and improve the safety culture within my own organization?

Culture is equivalent to a set of shared values held by the employees, the management, and the airport organization in general. Improving culture therefore means changing these values. However, changing individual and organizational values is not easy. Indeed, attempting to act directly on values is most likely to be met with cynicism, resistance and, ultimately, failure.

Changing values is a long process that can only be achieved by first changing practices. Therefore, safety culture promotion efforts should focus on altering practices, in combination with a demonstrable and visible change in management attitude and leadership. Establishing an effective SMS will assist in this process, but it is not sufficient.

We can distinguish two types of activities needed to promote and enhance safety culture: safety culture leadership and safety culture integration. Safety culture leadership aims to promote safety culture within each branch of an airport organization—e.g., operations, maintenance, engineering, emergency, security, human resources, finance, and information technology. Safety culture integration seeks to break the silos that often exist within large organizations and that constitute an obstacle to the effective exchange of safety information and management of interfacial safety issues (which are some of the most prevalent safety concerns for an airport operation).

There are many measures and activities that can help to strengthen safety culture. In practice, and for the purpose of this guidebook, we will consider the initiatives listed in Table 21.

Table 20. Example survey on safety culture.

Your position: ❍ Management ❍ Non-supervisory operational or tech staff ❍ Other _____ ❍ Supervisor ❍ Non-supervisory admin staff	
Rate each statement by selecting or circling the corresponding level of agreement to what you typically experience on your job. 1 = Strongly Disagree, 2 = Disagree, 3 = Not sure, 4 = Agree, 5 = Strongly Agree	
Management and supervisors regularly promote safety. *Management and supervisors visibly sponsor and encourage safety initiatives and practices, for example, by asking for, and being open to, suggestions from all staff on how to improve safety.*	1 2 3 4 5 N/A
My co-workers feel comfortable sharing safety concerns. *We always deal with our safety concerns in a friendly manner and my co-workers don't get upset if someone points out that something is not being done properly regarding the overall safety.*	1 2 3 4 5 N/A
My co-workers receive enough training to do their jobs safely. *The training that we receive makes us feel safe when we are doing our jobs. In addition, we received indoctrination training on safety immediately after we were hired.*	1 2 3 4 5 N/A
My Department's vision and mission for safety are clear. *We all know and understand where management stands when it comes to safety, and what it is trying to gain.*	1 2 3 4 5 N/A
My co-workers receive feedback from reports, suggestions, and concerns on airport safety. *Any time that we make a report or suggestion, or present an idea on how to improve safety, somebody gets back to us on what is going to be done about it, even if nothing will be done.*	1 2 3 4 5 N/A
My co-workers are informed of the lessons learned from safety reviews and investigations. *We are always informed of the conclusions of accident and incident investigations so that we can learn from them.*	1 2 3 4 5 N/A
Airport safety issues are effectively communicated between departments. *All information about safety issues is passed on to other departments, so that all are aware of them, regardless of which department experienced them.*	1 2 3 4 5 N/A
My co-workers respond positively when they receive safety reminders.	1 2 3 4 5 N/A
Unsafe conditions that cannot be immediately corrected are brought to the attention of management, or those who can do something about them. *When we notice an unsafe situation/procedure that we cannot correct, we inform the appropriate person to resolve it.*	1 2 3 4 5 N/A

Employee Empowerment

Empowering employees means giving them the ability to influence their environment. Experience with aviation and other industries has demonstrated clearly that empowering employees improves morale, productivity, and efficiency in all aspects of their work, not only with respect to safety.

With respect to SMS, empowering employees will lead to their involvement in the development of SMS at the outset. This last point is important. Many organizations feel that it is more

Table 21. Improving safety culture.

Safety culture leadership	Safety culture integration
▪ Employees empowerment	▪ Communication and marketing
▪ Demonstrated management leadership	▪ Integrated training
▪ Incentive programs	▪ Organizational performance measurement
▪ Non-punitive reporting	▪ Special events
	▪ Partnering

efficient to develop SMS and then market it to employees; however, this is less effective. Getting employees involved from the start saves time because it leads to an early "buy-in" and minimizes the risk of later resistance to change.

Some initiatives that could be considered when fostering employee empowerment include the following:

- Form a committee with broad vertical and horizontal representation to help define the corporate policy (which still needs to be finalized, endorsed, signed, and promoted by the senior executive), help define the non-punitive reporting policy and processes, develop corporate safety targets, etc.
- Ensure broad representation on the team(s) responsible for analyzing safety reports and proposing mitigation control actions.
- Get representatives from the major groups involved in the development of risk control action plans.
- Be responsive to employees' suggestions and ensure that they get feedback and recognition from supervisors and managers for their safety ideas and initiatives.

Demonstrated Management Leadership

Safety culture starts at the top!

The influence of management's attitude over the entire organizational culture often is grossly underestimated. Without effective and visible leadership from the top, the SMS will be nothing but a nice binder on a shelf.

Leadership is demonstrated through highly visible actions that confirm to the employees that management is really committed to safety and to all aspects of the SMS. How this is done depends on the type and style of leadership. There is no "cookbook" recipe, but the following are examples of initiatives that can be considered, modified, and customized to assist airport managers in promoting and integrating a strong safety culture within the organization.

Make Sure the Resources are Available to Achieve the Goals. The old saying of "do more with less" is not effective and sends the wrong message. If safety goals and programs are established, resources must be there to support them. Experience shows that the return on safety investments is well worth the initial cost.

Attend Safety Meetings. Senior managers should take a genuine interest in safety meetings and should attend them, at all levels. Clearly, senior managers cannot always be present at all safety meetings throughout a large organization, but their presence at some will send a strong message to employees that they care. However, token presence (such as protocol-opening by uninterested managers) should be avoided. Similarly, ceremonial attendance (i.e., special provisions made because the "big boss" is coming to the meeting) reduces the effectiveness of this participation. Ideally, attendance by senior managers should not be subject to any special provision.

Walk About. Managers often are perceived by employees as decision makers who conduct the show from behind their desk and do not really know what is happening on the "shop floor."

One easy way to break this perception is for senior managers to take periodic walks around the airside operations areas. This should not be restricted to the operations manager or others for whom this type of presence is expected, but should also involve all other members of the management team. "Walk abouts" are a great way to find out what is really happening. Asking questions and discussing issues with the operational staff at their place of work conveys a great sense of care and commitment. However, beware of "ceremonial" tours or inspections by senior managers, which are announced and turned into a special event, for which employees may have to prepare to be on their best behavior. If safety issues are brought up during such tours, ensure that feedback is provided on what management intends to do about it, and that the feedback reaches the concerned employees.

Communication with Employees. In periodic addresses to the staff, in writing or verbally, the senior manager should include safety and safety targets as a prominent item. This should be systematic, constructive, and positive. This systematic inclusion of safety in senior manager communications should extend to management meetings, airport operations committee meetings, and the like.

Incentive Programs

Safety culture is very much based on the concept that good behavior should be encouraged as much as or even more frequently than bad behavior is punished. Incentive programs are one way to encourage good behavior. Incentive programs can take several forms, including praise, recognition, or even monetary rewards. The precise nature of your incentive program depends very much on the type of culture and size of your organization. Not all the following suggestions will work for every organization. Most will need to be adapted to suit each airport's "personality."

Safety Employee of the Month. Under this type of program, one or more employees are recognized every month (or other frequency) for their ideas, suggestions, or contributions to safety within the organization. The reward can range from having the employees' names published on the intranet or public billboard system, to having employee photos displayed in the airport or in the airport's newsletter, magazine, or other suitable medium, to monetary rewards or gift certificates. This program can be enhanced further by having employees nominate candidates with justification and involving a selection committee composed of a reasonable cross-section of employees from all the airport's sections and departments.

Safety Team of the Month. This initiative is similar to the preceding one but focuses on teams rather than individuals, reinforcing the concept of teamwork. It promotes the idea that teams that work together win.

Competition. Competitions can be organized around a safety theme. As with the previous cases, these can be individual or team competitions, for example:

- Safety logo design competition
- Safety poster design competition
- Problem solving competitions
- Best article on safety, with the winning article to be published in a prominent magazine or newspaper

Care should be exercised in developing incentive programs that focus on lowering accident or incident statistics, because this can lead to underreporting.

Non-Punitive Safety Reporting

Non-punitive reporting is a key element of SMS and is discussed in Section 6.4 of this guidebook. A detailed explanation is not repeated here, but it is important to understand that this element is potentially one of the greatest "killers" of a strong safety culture. Building employee confidence and trust in a system that encourages reporting of even their own mistakes, without fear of reprisal, takes time and unfaltering efforts. Destroying this trust takes 1 minute.

Example of a non-punitive reporting system failure:

In an airport that prided itself on its program to implement non-punitive reporting, one employee immediately self-reported after making an honest mistake in the operations area. For reasons that are complex, but unimportant given the perception that ensued, the employee was fired. Regardless of the real reason for the firing, the perception among other employees resulted in a dramatic reduction in the reporting of safety hazards.

A properly designed safety suggestion program can also be incorporated into the reporting system. It is important that the airport provide feedback for each suggestion submitted.

Communication and Marketing

Some communication and marketing initiatives can be aimed specifically at integrating safety culture across the entire organization. As with the other initiatives previously mentioned, the following examples need to be adjusted to fit the size and characteristics of each airport.

Safety Newsletter. Safety newsletters published on a regular basis are a great way of promoting safety issues across the organization. They also provide a means of informing external stakeholders, which further enhances the integration of safety cultures.

Safety Page. Many airports have a magazine published monthly or quarterly, or have access to another type of trade publication through which they can publish articles and information. One idea is to establish a "safety column," where safety information is discussed, new safety initiatives are presented, and winners of incentive programs are reported.

Newspaper and Media. When significant safety programs or projects are initiated, media information focusing on the airport's effort is an effective way to develop employee pride in the project.

Safety Posters. Posters are a passive training method used to remind employees of a hazard, precaution, or idea (see Figure 12). Posters must be current and have a message applicable to the audience. Change them frequently so they don't become part of the décor. For staff members who have access to computers, a brief safety message on the airport intranet homepage may be more effective than posters.

Establish a "Safety Promotion Team." Creating a team of representatives from several levels and sections can greatly enhance not only the integration of subcultures but also the effectiveness of the safety promotion program.

School Involvement. In some small communities, where the airport occupies a prominent place in the economy, getting schools involved through, for example, essay competitions, airport visits, or other activities can enhance the sense of community among employees (who may work in different departments but whose children all attend the same school).

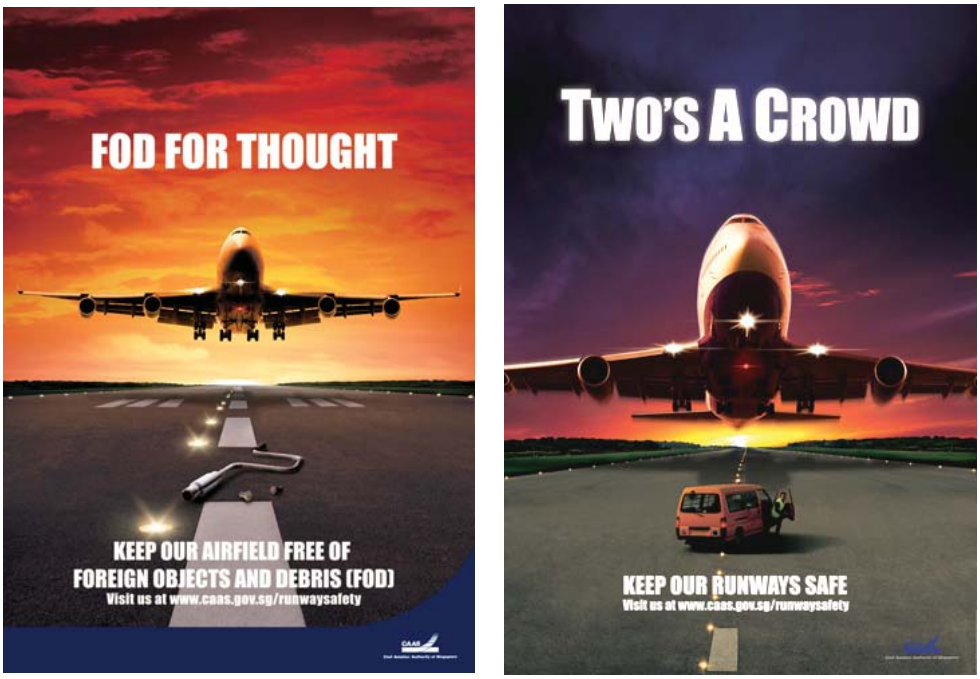


Figure 12. Safety posters (courtesy of Civil Aviation Authority of Singapore).

Integrated Training

Training should be recognized as a great potential safety culture integrator. Many traditional training programs focus on functional groups or levels. For example, there may be a leadership course for managers, a safety course for duty managers, or something similar. Strictly functional or single-level courses tend to reinforce divisions between groups within the organization. An integrated course brings together managers and staff from various departments and can help break down the barriers. Even when the course is predominantly focused on one functional area, everyone benefits from understanding what others do. Experience has shown that training is a very effective way of integrating subcultures within an organization.

Safety Performance Measurement

There are many possible safety performance indicators, and they are all useful in evaluating the success of the airport SMS. However, some performance indicators are especially helpful in integrating safety subcultures across the organization. To be effective, such performance indicators should be organizationwide and publicized. They should instill pride in the organization's operation. They can also be compared with similar organizations or industry averages in an effort to promote healthy competition. For example, the following indicators, when normalized against a reasonable timeframe, could be considered positive safety culture integrators:

- Number of incidents
- Percentage of incidents considered serious (over the last month, for example)
- Number of employee suggestions that have resulted in concrete safety improvements
- Number of outstanding safety action items
- Percent of strategic safety activities completed (in the current year)
- Organizationwide safety audit score

Special Events

Special events focused on safety, when they are attended by people across different departments and levels, can greatly enhance mutual cooperation and safety culture integration. Note

that airport service providers (airlines, fuel providers, FBOs, catering, commissionaires, etc.) should also be considered key potential participants. There are many types of events that can be organized or attended by the airport staff, for example:

- Safety conferences and workshops (note that hosting such a conference at or near your airport greatly enhances the promotion and integration benefits).
- Safety campaigns, such as an "annual FOD walk," recruiting airport employees to volunteer to participate walking the full length of the runway removing FOD. Such events can be followed by a staff luncheon or other event.
- Safety-sponsored family days.

Partnering

It is essential to the success of airport planning as well as to its SMS to establish the philosophy and practice of continuously involving and consulting with the airport stakeholders. Without proper and regular consultation with the FAA, airport tenants, and service providers, airport plans may be flawed. Not only do they know best how they work and what is needed for a safe and efficient operation, but it is likely that there is a wealth of expertise available within their own workforce. Partnership in planning should exploit all the knowledge, experience, and ideas from all stakeholders[32]. A further benefit is the cooperation and good relationships that can be formed by communication and consultation.

Partnering with stakeholders makes it easier to communicate the rationale for decisions and, ultimately, gain acceptance by those who will be affected by them.

For example, when developing SOPs affecting the ramp area, it would be a mistake if the airport did not consult with the stakeholders having activities at the ramp.

The airport operator normally will lead and direct the consultation process, which should include aircraft operators, ground handlers, and those contractors providing basic aircraft services such as catering, aircraft cleaning, and fueling. Where appropriate, the FAA and ATC should be involved. It is important that representation be at a suitably senior level to ensure sound input and decision making.

It is recognized that a direct lack of coordination among key airport functions is an important factor in accidents and incidents. Long-term and sustainable improvements in airport safety can be achieved only through the collective commitment and joint efforts of all airport stakeholders.

Partnering with other safety-related organizations[32] and affiliates will demonstrate a public commitment by leadership. Enlist the support of your target audiences where possible. Involve associations or representatives of your target audiences to disseminate information or, better still, as campaign partners. This can give your campaign greater credibility.

You can identify partners who not only share your commitment but who can also share the resources needed for the campaign. It is important to understand and acknowledge the functions, priorities, and strengths and weakness of your partners. Be aware of cultural differences when operating across borders, and establish channels and forums for exchanging information and ideas regularly. Be clear who is taking responsibility for what activities and that the decisions taken are understood by all.

Possible partners may include the following:

- Airport tenants and service providers
- The FAA

- Aviation industry associations
- State and local government
- Other airports
- Labor unions
- Local schools and colleges
- Institutes
- Other units of the airport organization
- Media

Do not rely on getting media coverage to promote your campaign because this cannot be guaranteed.

6.3 Cascading Meetings

"Cascading meetings" is a technique that allows for a more dynamic communication environment that will inform employees and increase engagement by providing a clearer line of sight between their day-to-day efforts and safety issues being discussed at the airport. With cascading meetings, communications are passed down through the hierarchy in a consistent manner, and all employees have a chance to be heard as they discuss the operations and changes taking place.

The objective of cascading meetings is to improve communication within the airport organization. It should be a two-way process, with feedback from lower levels going all the way to the top. Discussion topics may include any safety-related subject, for example:

- The airport's vision, mission, values, and principles
- SMS processes
- Continuous improvement actions
- SOP
- Safety objectives and performance indicators
- Specific safety issues and lessons learned
- Safety promotion

Cascading involves each manager sitting down with his/her immediate team for a series of meetings. These meetings should enable everyone at the airport to understand and become aware of the discussion topic. Suppose the airport needs to discuss its vision and values to strengthen its safety culture. The basic concept is to cascade level by level throughout all departments until every staff member understands and is committed to the ideology of the airport. In this case, the effort is normally annual or periodic extending over a number of years.

Leading a Cascading Meeting

The managers should lead the meetings with their teams. Using a facilitator may not be effective. In the example previously described, it is important for team members to hear about the airport's ideology from their direct leaders, who should be committed to the airport's policies and goals.

When using an outside facilitator to lead cascading meetings, make sure you have a skilled person that is trusted by the employees.

The leader's purpose in these meetings is to promote discussion among team members. The leader should stay out of the discussion as much as possible after the initial explanation. Talk only as necessary to keep the team members talking.

The leader should not give the impression that the airport's vision, values, and principles are being rammed down employees' throats. Commitment will come only after employees have voluntarily accepted those principles following open and frank discussions. Each meeting leader should explain, give examples, and discuss what the airport's ideology means to him/her; however, the leader should not engage in a long tirade about the ideology should be adopted.

The Cascading Process

Cascading is a top-down, bottom-up discussion process that progresses through the organization one level at a time. The first series of discussions is between top managers and their next level of managers. As shown schematically in Figure 13, the Executive Director meets with the heads of departments, then additional meetings are held between each department head and the head of each section within the specific department, and so on.

At the end of each series of discussions, the safety issues in the airport are passed down to the next level for discussion. Proposed changes and unanswered questions will go up until they are resolved or answered. Attendees at one series of discussions will become leaders of the next series. The actual number and length of the meetings should be determined by the local organizational structure and situation.

> Cascading meetings are most effective for organizations like large hubs. Smaller airports will benefit little from this technique; however, they should still hold meetings to discuss their safety issues.

Cascade meetings may be used within a specific department or section of the airport. For example, when discussing safety objectives of the operations department, discussion will take place among staff within the operations department.

Rationale and Pitfalls

Most airports have a range of communication processes in place for cascading information via meetings, email, newsletters, intranet, message boards, and so forth. But the emphasis needs to be on two-way communication. It is assumed that corporate messages are received, understood, and supported, but all too often, the true message gets lost in transit. Not everyone finds time to read the newsletters and emails.

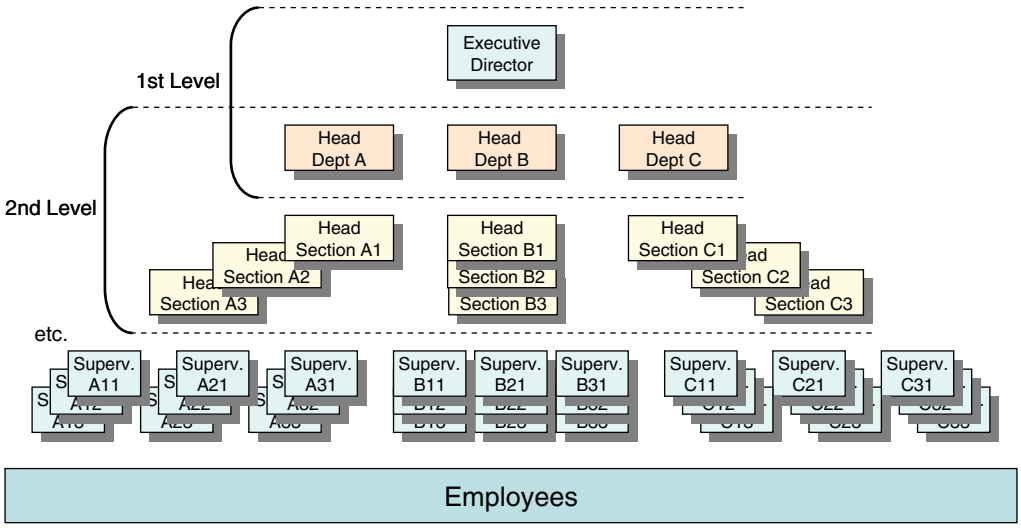


Figure 13. Cascade meetings process.

Posting information on an intranet and giving employees responsibility for keeping up to date is one of the latest forms of communication. While fast and flexible, accessing the intranet may be low on the list of priorities for busy people. Cascade meetings can be effective, but even the best managers do not always put the message over in the most timely or persuasive way; not everyone checks that staff have understood, and few check that individual staff members know what the communication means to them and to their role.

Figure 14 depicts two cascade meeting processes. In the first situation the communication runs smoothly from the upper to the lower levels of the organization. In the second one, somewhere along the flow process, the information is truncated and not effectively passed to lower levels.

Cascading meetings are not always effective. Some of the reasons include the following:

- Managers may resist holding the meetings
- The issues are poorly delivered and lack effectiveness
- Understanding of the issues is not consistent
- Feedback process is sanitized
- Effectiveness of the process is not evaluated

6.4 Safety Reporting

With SMS and a strong safety culture to support it, airport employees gain self-confidence to report hazards, incidents, accidents, and errors. There are additional benefits generated with SMS reporting including the following:

- Workers are willing to share their errors and experiences
- They become more knowledgeable regarding SMS as a whole
- People become motivated to learn new lessons and are more comfortable and helpful when implementing new approaches to improve safety
- They are aware of what is considered acceptable and unacceptable behavior

Possible means for safety reporting include the following:

- Hardcopy forms and drop-boxes available at various airport locations
- An intranet and/or Internet SMS webpage with safety reporting capability
- An airport safety phone hotline
- Managers and supervisors meetings
- Daily briefings, tasking, and debriefings
- Intranet/Internet messages

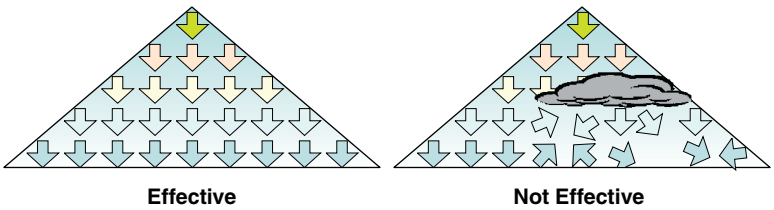


Figure 14. Possible outcomes of the cascading meeting process.

From the implementation of a good SMS flows a solid hazard reporting system[33] with at least the following characteristics:

- Voluntary, impartial, confidential, and non-punitive (so as to generate trust in the individuals providing information). Legal counsel is appropriate to check how applicable laws may impact confidential and/or non-punitive reporting systems.
- Easy to be reached by any airport employee or stakeholder (auxiliary service companies or airlines, passengers, and other airport users) to report a hazard
- Able to ensure that recommendations resulting from the investigation are available to the airport operator for information and resolution purposes
- Presented in oral or written form. In all cases, reporting must be documented
- Able to safeguard confidentiality
- Adequate for documenting reported hazards and prompt evaluation of the safety issue
- Able to include a response to the reporting party as to the action taken, and its dissemination to the organization, if the airport operator deems it necessary
- Managed by the SMS Manager, who is operationally responsible for monitoring the status of hazards identified
- Engenders sufficient trust that people are willing to report their errors and experience
- Encourages (sometimes, rewards) people to provide safety-related information

A good way to get the reporting system working is by raising employee awareness of the purpose of the system. An example of a safety reporting form is depicted in Table 22.

Reporting systems are one of the most significant ways of obtaining safety information. You cannot fix something if you do not know what is wrong. However, many systems fail because of the lack of adequate and timely feedback to personnel or follow-up actions.

A non-punitive reporting system may encourage people to report events that might otherwise not get reported. This would allow you to get more information about hazards in your operation before an accident happens.

Setting up a non-punitive reporting system requires a lot of planning and careful design. The purpose is to encourage reporting by removing fear of punishment. However, that does not mean that people can get away with negligent behavior or with willfully breaking rules. This can sometimes lead to situations where the administration of discipline can be perceived as inconsistent. It is important that everyone understands when punitive actions will or will not be taken.

Moreover, the airport has no authority over other organizations (e.g., tenants). Airport contracts and lease agreements may need to have specific clauses to address such a policy before it can be established by the airport operator.

Table 22. Example of safety reporting form.

VOLUNTARY SAFETY REPORTING FORM		
This form should be used to report any airport hazard that has caused or could cause an accident or incident. Send to the SMS Manager as soon as possible after the hazard has been identified or an incident/accident has occurred.		
1 PERSONAL DETAILS (person reporting)		
Name: (optional)	**Position:** (optional)	**Contact info:** (optional)
2 INCIDENT/HAZARD DETAILS		
Date:	Time: AM/PM	Shift: Day: ☐ Afternoon: ☐ Night: ☐
Location:		
Brief Description of Incident/Hazard: (attach diagrams, sketches, or photographs, if available)		
Are there witnesses?: YES: ☐ NO: ☐	**Names of witnesses:** (optional)	
Type of Incident/Hazard	**Level of Injury (If applicable)**	Brief description of injury/damage
Health and/or Safety ☐	No Injury ☐	
Property Damage ☐	First Aid ☐	
Environmental ☐	Medical Treatment (Doctor) ☐	
Near Miss ☐	Hospital Inpatient ☐	
Other ☐	Fatal ☐	
Confidentiality Commitment		
You can submit the form anonymously (if you so chose) by omitting relevant details. If you do provide your name, it will only be used by the SMS Manager to enhance the understanding of the event with follow-up actions should that be required; and, under no circumstances, will your identity be disclosed to any person or organization without your express permission.		

At large and medium airports, safety reporting may require a more formal procedure because the organization may have many layers and sections, making communication more difficult to achieve. At small airports, particularly those for general aviation, communication tends to be more effective and is normally performed on a daily basis. A less formal procedure is recommended for small airports.

However, even for general aviation airports, it is important to keep track of what and when a safety issue was reported, and which actions were taken to solve or mitigate the risks involved. A simple spreadsheet should be sufficient for this purpose.

Table 22. (Continued).

SAFETY REPORT PROCESSING FORM (To be completed by SMS Manager)	
Report Number: Date report was received:	Assessed Level of Risk:
Referred to: - Appropriate Dept Manager: ☐ Yes ☐ No, Name/Dept…… - Safety Committee: ☐ Yes ☐ No, Name/Organization……	
Entered into Safety Risk Database: ☐ Yes ☐ No If yes, specify the date.	
Treatment actions required: **Person responsible:** **Completion date estimated:**	
Feedback: Is reporter known? ☐ Yes, advised of outcome on: Date: ☐ No, event and action communicated on: Date: **Through:** ☐ Safety bulletin ☐ Safety meeting ☐ Ramp Safety Committee minutes ☐ Other Safety event (describe):	
Person completing form: _____ Signature: Date: _____ Manager/Supervisor: _____ Signature: Date: _____	

The Freedom of Information Act (FOIA) is applicable to information controlled by the United States government. Each state has its own open records legislation that governs documents at the state and local (cities, counties, school districts) levels.

Such legislation may be applicable to your airport. In this case, you must include a note in your Confidentiality Commitment stating that the airport may have a legal obligation to provide all information that is available, including the reporter's identity, if this information is requested and it is available in the airport's records.

6.5 Accident and Incident Investigation

Accident investigation is a key component of any SMS. Thousands of accidents occur each day in the United States, some of which could be prevented by identifying the underlying causes of the accident and implementing appropriate corrective actions[34]. An accident investigation

program is a safety management tool used to identify the contributing factors and causes of an accident in order to eliminate or mitigate these factors and ensure that similar accidents are not repeated.

A qualified investigator is a person that has received training on how to conduct investigations and determine root causes of incidents and accidents. When an accident or serious incident occurs, qualified investigators should be available to conduct the investigation with the following purposes:

- Improve understanding of the events leading up to the accident/incident
- Identify root causes and assess actual hazards
- Provide recommendations to mitigate risks
- Communicate lessons learned from the investigation

In many instances, the investigation of minor incidents, such as near misses at the ramp, may yield evidence of systemic hazards. For maximum effectiveness, the investigation should focus on determining root causes rather than identifying persons to discipline.

The causes of an accident/incident can often be found by asking

Who + What + Where + When + How + Why

for each key event in the accident/incident until you know why the accident happened.

Separate facts from theory and opinion

As much as possible, look for underlying causes—avoid jumping to conclusions. Analyze the factors surrounding the accident.

It will be necessary to provide appropriate training on topics such as human factors, investigation procedures, or interview techniques to some of the appointed personnel. However, you do not need to provide this training to all staff within the organization; you might want to focus on training lead investigators first, for example. Section 6.6 provides additional information on internal safety investigations.

Fortunately, since accidents in the aviation industry are rare, you can get a great deal of knowledge and experience by obtaining reports of significant events from external organizations[35], such as regional or international accident or incident reports (e.g., National Transportation Safety Board [NTSB], ICAO, Transportation Safety Board of Canada, UK Air Accidents Investigation Branch).

Accident Causes

An accident is defined as an unplanned, undesired event that affects the completion of a task. At its lowest level, an accident occurs when a person or an object is exposed to an unsafe level of energy or hazardous material. There are many forms of harmful energy, including acoustic, chemical, electrical, kinetic (impact), mechanical, potential (stored), radiant, and thermal. Acci-

dents are complex, sometimes involving 10 or more events that can be considered contributing factors. Most accidents have three different cause levels: root, indirect, and direct.

The direct cause of the accident would be the energy or hazardous material. The direct cause usually is attributable to unsafe conditions and/or unsafe actions. The unsafe conditions and actions are considered to be indirect causes or symptoms. The indirect causes are typically a result of root causes, which may include an inappropriate procedure for the work or task, adverse environmental factors, personal judgment, and/or poor management decisions. The relationship between root, indirect, and direct causes is shown in Figure 15.

Most accidents are preventable by simply eliminating one or more of the causes. Proper accident investigations are crucial for determining what happened and how and why it happened. The goal of accident investigation and reporting is to minimize the chance or reoccurrence and in turn to prevent more severe accidents in the future.

Types of Events

All incidents have the potential to become injury-related accidents and should be investigated. The following terms explain the different types of events that should be investigated to determine the incident's contributing factors:

- Accident—An accident is an undesired event that results in personal injury or property damage.
- Incident—An incident is an unplanned, undesired event that adversely affects completion of a task.
- Near Miss—Near misses describe incidents where no property was damaged and no personal injury was sustained, but given a slight shift in time or position, damage and/or injury easily could have occurred.

Accident and incident reports help identify hazards and other contributing factors that may have been overlooked or slipped through the system. They also identify hazards that have the potential to become serious accidents.

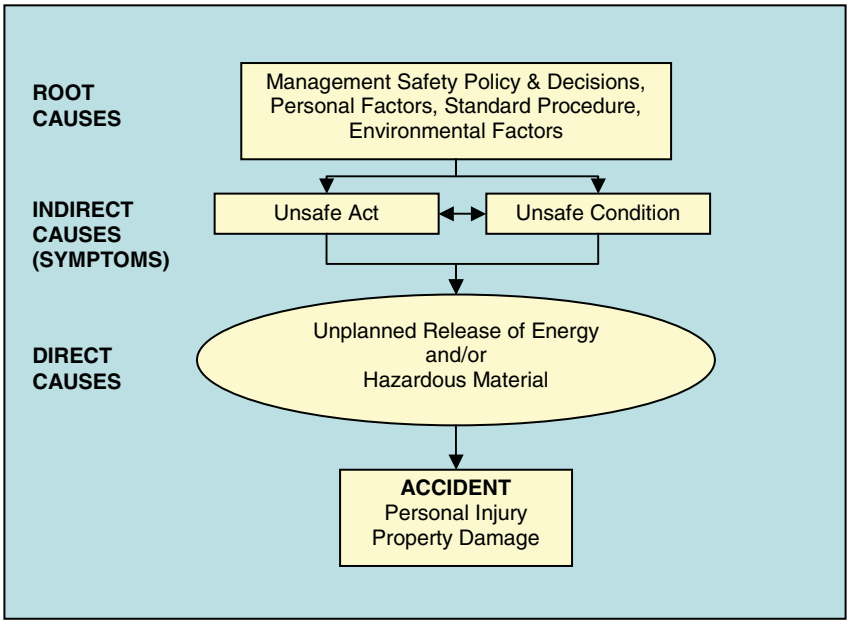


Figure 15. Accident causes.

Investigation and analysis follow reporting, hazard identification, or high risk concern. Usually the investigation is conducted by a team/person with experience in the area of concern.

Investigation Analysis Techniques

There are three techniques commonly used to help understand the underlying causes of incidents: the Causation Model, the Fishbone Analysis, and the "5 Whys."

Causation Model

The basic causes of incidents can be grouped into the five categories shown in Figure 16: task, materials, environment, personnel, and management. All possible causes in each of the categories should be investigated when using this technique.

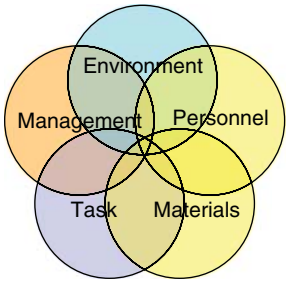


Figure 16. Causation model.

Task. Looking at the causes associated with a task involves exploring the procedure that was being followed when the accident or incident took place. Questions such as "Is the work procedure safe?" and "Were the tools and materials used appropriate for the existing procedure?" should be asked and the answers documented.

Materials. The materials used should be investigated to determine if any possible causes or contributing factors can be associated with materials and/or equipment. Questions about equipment failure, possible failure mechanism, design, maintenance, hazardous materials, and so on should be asked, and answers should be documented.

Environment. Environmental conditions have been known to contribute to unsafe conditions and are often a contributing factor in an accident. The actual conditions at the time of the accident and any sudden changes in the environment that could have occurred near the time of the accident should be the focus of the investigation.

Personnel. The condition of the personnel (both mental and physical) must be considered as part of this analysis. Again, the objective is not to place blame on an individual, but rather it is to get to the root of the problem and all possible angles should be explored. Questions about employee training, frequency of the work, employee health status (both physical and mental), and so on should be asked.

Management. Management personnel and safety policies should be considered during an accident investigation. Ultimately, managers are decision makers and they have a legal responsibility to promote safety in the workplace. Some of the direct and indirect causes of an accident are due to failures within a management system. Questions concerning safety policy and procedures, inspection schedules, employee supervision and training should be addressed.

The causation model is a good tool for determining the causes associated with a specific accident or incident. It is important to note that, when using this model, each time a question reveals an unsafe condition that particular question should be followed up by another question that addresses why the unsafe condition was allowed to exist.

Fishbone Analysis

This analysis is used in more complex investigations and is particularly useful when many experts are gathered. Typically, each will have his or her own particular expertise and concerns, and the fishbone analysis focuses all participants in the investigation to defined aspects of the operation. An example outline of the technique is shown in Figure 17. The group will include the elements determined from the brainstorm session.

In this example, all participants are asked to focus on issues related to defined topics—equipment, people, materials, and programs/procedures. Each is discussed in turn, and concerns for

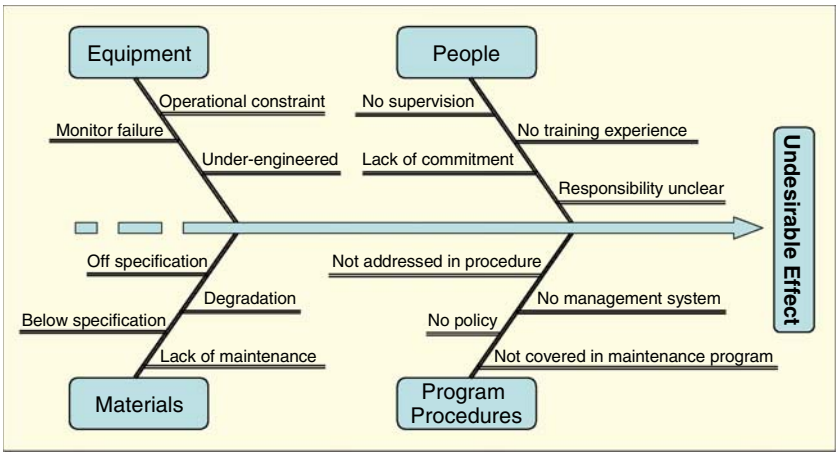


Figure 17. Fishbone investigation process.

each are written on the diagram. Other defined topics may be added at the discretion of the investigating team. At the end of the analysis, the resultant fishbone will look somewhat like the example shown.

The concerns identified are then investigated in detail to get to the root causes of the issue. It can be seen clearly that this technique will allow for multiple root causes, ranging from mechanical to human and organizational factors.

"5 Whys"

The following is a simple example of the questioning technique used in the "5 Whys." In this example, depicted in Figure 18, a driver that was hired by a contractor to conduct a construction job on the airside failed to follow the directions from the escort vehicle. The incident resulted in a runway incursion because the driver was not able to speak or understand English; therefore,

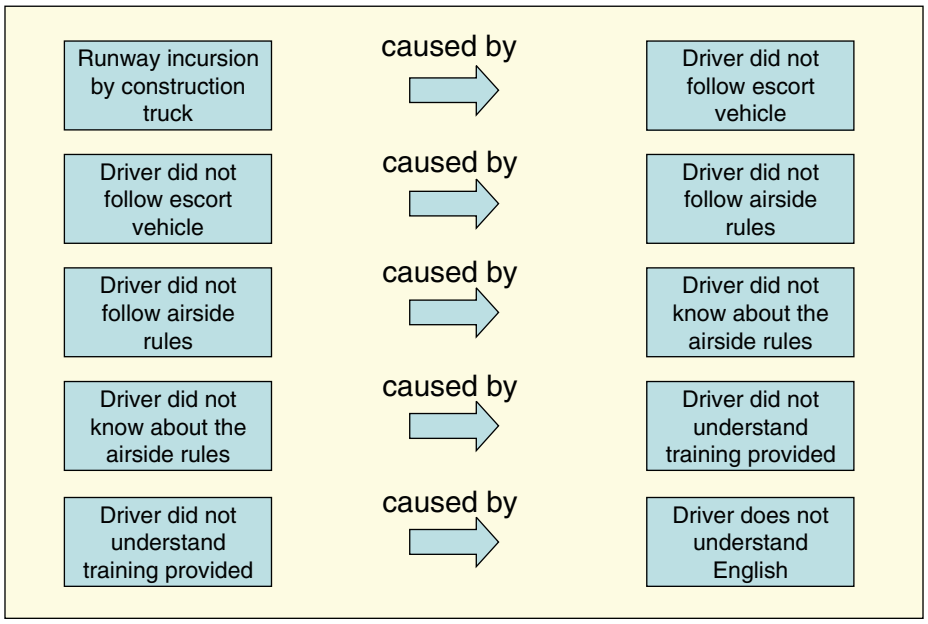


Figure 18. "5 Whys" investigation process.

the training provided was ineffective. The escort person was not aware of that. The important point is that the investigation discusses issues that would preclude repetition of the problem.

Typically, once the issues in the fishbone have been identified, the "5 Whys" technique is applied to each factor in an attempt to find the root causes of each. These techniques allow a skilled team to focus on different aspects of an issue so that all the underlying causes can be addressed. It ensures that no one person is able to dominate the discussion with preconceived ideas, and it also allows both hard engineering issues and human factors issues to be drawn out equally in discussions. It is not normal for people to want to make mistakes, and so these techniques try to ask why people found themselves in the position to make the error in the first place.

Getting the Facts

The goal of conducting an accident or incident investigation is to gather information that can be analyzed that will lead to the improvement of the airport safety policy and reduce the number of accidents that occur. The following four steps are necessary for creating such a system:

1. Gather Information
2. Analyze Information
3. Draw Conclusions
4. Make Recommendations

It is important to gather information from all available sources, which may include, but are not limited to the following:

- **Physical Evidence**—Physical evidence is defined as "tangible evidence" (e.g., aircraft damage, picture, document, or visible injury) that is in some way related to the accident/incident that gave rise to the case. Examples include the equipment or materials left at the scene of the accident, the position of injured persons or other objects, the weather conditions, and documentation of the involved persons or conditions. All physical evidence should be examined and documented.
- **Eyewitness Reports and Interviews**—It is important to gather information from any eyewitness reports and, if possible, conduct interviews with all parties involved. Interviews should be conducted from a "fact finding" rather than a "fault finding" perspective.
- **Background Information**—All policies, procedures, inspection reports, maintenance reports, and other relevant documents should be considered, and appropriate information should be acquired as part of the investigation.

Once all of the information is collected and one of the analysis techniques above is used, the team of investigators should work to draw conclusions. When drawing conclusions, it is important to answer "why" the accident occurred. It is also important to support and document the root causes with evidence and reasoning.

Drawing conclusions based on the gathered information may lead to gaps in the original analysis. If gaps are discovered, the existing information should be re-examined. Sometimes, additional information may need to be gathered to bridge these gaps.

The final step is to draft written recommendations for corrective actions to take, and if relevant, to improve safety policies and procedures. This step is extremely important to reduce and prevent accidents of a similar nature from occurring in the future. The written recommendations should be as specific as possible and address all root causes and contributing factors. Management should address all recommendations from accident and incident reports by updating safety policy and procedures if necessary.

Table 23. Example of accident/incident investigation form.

Accident/Incident Investigation Form	
Date: Investigator:	Airport: Incident form number:
Date of incident: Time of incident:	Injured person: Type of injury:
Property damage: ☐ Damage to aircraft by apron equipment ☐ Damage to/by moving aircraft ☐ Damage to property/equip. ☐ Equip. to equip. damage ☐ Equip. to facilities damage ☐ Damage from wildlife ☐ Other (describe)	Brief description of incident:
Witnesses:	
Immediate/short-term actions to prevent recurrence:	
How long has the person conducting the task been working prior to the incident/injury occurring?	
How long had the person conducting the task been working on the task?	
Is this task part of the normal duties for the person conducting the task?	☐ Yes ☐ No
Had the person performing the task been instructed/trained in how to perform it?	☐ Yes ☐ No
What were you doing in the time prior to the incident/injury?	
What were other factors involved? If other, please specify.	☐ Environment ☐ Equipment ☐ Hazardous Substance ☐ Other

(continued on next page)

An example accident/incident investigation form containing helpful information to be gathered is presented in Table 23. In the last portion of this form, the investigator may describe some risk control options. The arrow indicates the priority that should be adopted for these actions.

6.6 SMS and Internal Safety Assessments

Continuous improvement is one of the core concepts addressed by an SMS. To help airports verify that management efforts are focused in the right direction and that the objective of continuous

Table 23. (Continued).

Accident/Incident Investigation Form	
ENVIRONMENT	
Was there an acceptable standard of safe conduct in play? If no, provide details:	☐ Yes ☐ No
Was there good visibility? If no, provide details:	☐ Yes ☐ No
Was there adequate lighting? If no, provide details:	☐ Yes ☐ No
Was there adequate means of access?	☐ Yes ☐ No
What was the precipitation condition? ☐ Dry ☐ Hail ☐ Rain ☐ Drizzle ☐ Snow ☐ Other, specify:	How was the Surface condition? ☐ Dry ☐ Ice ☐ Snow ☐ Wet ☐ Slush ☐ Standing water
EQUIPMENT	
Did any equipment/vehicle contribute to the incident? If yes, provide details: Description of Equipment: Type: Make:	☐ Yes ☐ No
Did the design/quality of the equipment/work area contribute to the incident? If yes, provide details:	☐ Yes ☐ No
Did the location/position of the equipment contribute to the incident? If yes, provide details:	☐ Yes ☐ No
Had the hazard/risk been recognized previously? (e.g., Pilot Report, incident report, hazard report, etc.)	☐ Yes ☐ No
Were employees informed/aware of the hazard/risk? If yes, provide details:	☐ Yes ☐ No
Was the equipment in good working order? If no, provide details:	☐ Yes ☐ No
Date equipment was last serviced:	
Was the correct equipment being used for the task? If no, provide details:	☐ Yes ☐ No
Was the equipment being used correctly? If no, provide details:	☐ Yes ☐ No

improvement is being achieved, SMS incorporates a set of specific tools to measure improvement over time. Some of the most valuable of these tools are the **SMS self-assessment** and **internal safety assessments,** which are part of the Safety Assurance pillar of SMS.

The SMS self-assessment process also offers a unique mechanism that "checks and balances" the SMS to ensure that its pillars and elements are working effectively. Internal safety assessments help evaluate how effectively individual units of the airport (e.g., maintenance, ARFF, dispatch) are

Table 23. (Continued).

Accident/Incident Investigation Form	
PROCEDURES/SIGNAGE	
Was there appropriate safety signage displayed?	☐ Yes ☐ No
Were there SOPs for the task?	☐ Yes ☐ No
Had employee/s been instructed/trained in the SOPs?	☐ Yes ☐ No
Had employee/s been deemed competent and understood the SOPs?	☐ Yes ☐ No
Were safe working systems observed? (e.g., isolation procedures)	☐ Yes ☐ No
Was the workload considered excessive? If yes, provide details:	☐ Yes ☐ No
Was the task repetitive? If yes, provide details:	☐ Yes ☐ No
HAZARDOUS SUBSTANCES	
Was an MSDS (Material Safety Data Sheet) available?	☐ Yes ☐ No
Were the storage/handling/disposal of the substance(s) adequate? If no, provide details:	☐ Yes ☐ No
TRAINING/SUPERVISION	
Was the employee/s physically capable of doing the task? (e.g., good health, no disability, recovering from illness). If no, provide details:	☐ Yes ☐ No
Was there frequent supervisor/employee/s contact to discuss/review hazards and job procedures? (e.g., safety meetings, daily briefings). If no, provide details:	☐ Yes ☐ No
ANY OTHER FACTORS INVOLVED? Please explain:	
Investigator's comments and observations:	

(continued on next page)

working relative to safety and if they have the right resources to achieve their safety goals. When agreed between the parties, the airport may want to conduct safety assessments on the operations of airport stakeholders (e.g., tenants) to ensure they are operating in line with the airport rules and regulations, that they have staff that is adequately trained, and that their resources (e.g., equipment) are appropriate and in good condition to work safely in the airport environment.

These assessment processes are **internally initiated examinations** of the performance, activities, systems, and processes in place within the airport related to SMS and safety. In general, an SMS assessment is performed on an annual basis. Safety assessments normally focus on areas that are most deficient; however, every airport unit should be assessed regularly (e.g., every other year).

The goal of an assessment is to have an open and transparent "second look" at the processes and resources to identify areas where improvements may be needed. It is a tool to evaluate how

Table 23. (Continued).

Accident/Incident Investigation Form			
Risk Control Options	**Action Required**	**By Whom**	**By When**
Avoidance—does the operation need to take place? Or do you have to do the task?			
Transfer—is there another way you can manage the operation or do the task?			
Control—can you engineer a way to make the operation/task safer? e.g., eliminate the hazard, substitute operation, use engineering and/or procedural controls.			
Date and feedback provided to person reporting the injury/incident:			
Investigation Completed By:	Print Name:	Sign:	
Position:		Date Completed: / /	

effectively the airport is working toward improving safety. These evaluations will include (a) reviewing and evaluating the actions taken to ensure that they are producing the desired effects and (b) monitoring business activities and their impact on safety to determine where efforts should be directed.

Audit Versus Assessment

You may hear the terms **assessment** and **audit** used interchangeably. However, while it is true that the processes and activities associated with each are very similar, in the context of SMS, they are technically different. **Audit** focuses on compliance and conformance to a given standard and is based on factual verification of non-conformance, usually associated with prescriptive regulations. **Assessment** focuses on the effectiveness and efficiency of an SMS and collects data to make judgments on its performance. Table 24 provides examples to help differentiate between assessment and audit.

In some countries, SMS has been adopted and promulgated as a performance-based regulation. This means that, while the regulator is seeking to achieve a certain outcome, the means of achieving this objective is, for the most part, left to the regulated party (i.e., the airport). In the context of SMS, **assessment** is then the most suitable term to define this process. (Note that much of the international literature concerning SMS calls an assessment an **internal audit** or **self-audit.**)

Assessment Principles

Inspections, evaluations, and the like are guided by a series of principles or characteristics that verify that the outcomes have achieved their objectives. SMS and safety assessments are no different. The following are some of the key principles that need to be observed when performing an SMS or an internal safety assessment.

Table 24. Examples of audit and assessment.

	Requirement	Measurement	Outcome
Audit	**139.305 Paved areas** …The pavement edges must not exceed 3 inches difference in elevation between abutting pavement sections and between pavement and abutting areas.	The auditor/inspector would physically measure difference.	If the difference is more than 3 inches: **Non-Compliant;** if it is 3 inches or less: **Compliant.**
Assessment	An airport should have a safety policy in place	Is the policy documented? Is it effective? Is it communicated? Is it periodically reviewed? Is it signed by the AE? etc.	Based on the judgment of the assessment team, this requirement is evaluated on whether it satisfies the principles of the SMS or not, and if it is effective for the size and complexity of the airport. If improvements are necessary, the assessment team will provide recommendations.

Internally Initiated

Traditionally, airports and other aviation organizations have relied on periodic certification inspections by the FAA to identify non-compliance and to obtain recommendations on corrective actions. SMS steers away from this approach and calls for airports to take the initiative for periodic assessments to review all operational processes of SMS and safety. These internal assessments evaluate the performance of the processes and the resources available to determine whether and how they are achieving their objectives. Based on these assessments, corrective measures can be taken, if improvements are needed.

Comprehensive

To ensure that the results and observations of the assessment are accurate and representative, an effort should be made to include all processes, activities, departments, resources, and levels of personnel affected by the scope of the SMS. Depending on the size of the airport, the complexity of the operations, and the availability of resources, the scope of an assessment may vary. The assessment may cover the whole spectrum of an SMS in a single exercise, or it could be scheduled in such a way that different areas or units are targeted independently. If the latter approach better suits your airport, make sure that, at the end of each cycle, all areas and aspects of SMS have been covered.

Independent and Objective

Dealing with the everyday activities of airport operations can create diverse and, sometimes, conflicting priorities. It is important that, in this environment, you focus on safety and that the processes put in place to support the SMS remain relevant and practical.

A fresh look from a party that is not immersed in and directly affected by day-to-day activities would provide the objectivity necessary to assess your SMS and safety performance. Some larger airports might have an audit function/department within their organizational structure. If this is your case, you can take advantage of this support to perform the assessment. Other large airports that do not have an auditing department may consider performing cross-departmental assessments under the direction of the SMS Manager or another experienced facilitator.

For medium and small airports, it may be a challenge to find the necessary level of objectivity and independence in house. The logical choice would then be to seek outside help. An approach that might suit your airport is to make a bilateral agreement with other similar airports in the region to perform each other's SMS assessments.

Of course, airports large and small could also secure the services of an outside independent firm to perform their SMS assessments if none of the approaches works for them.

Having an external person/team perform the assessment does not violate the principle of an internally initiated examination since the initiative to review SMS performance comes from the airport and not from an external agency.

Frequency

The frequency and scheduling of SMS and internal safety assessments should be related to the risks identified with specific activities or functional departments and the results of previous assessments. In general, such assessments are performed annually or biannually. Unscheduled or ad hoc assessments should take place when significant changes or events occur, such as a major organizational restructure or an accident.

Assessment Methodology

This section provides a high-level overview of how an assessment is carried out and the steps necessary to accomplish one successfully. Every airport or external organization will set up an assessment process that best serves its needs, but in general, it will basically follow the steps depicted in Figure 19.

The assessment methodology and the tasks described in this section are appropriate for large and medium airports. The checklists and tables are applicable to smaller airports as well; however, the methodology can be less formal. A large airport may have a team to conduct the assessment, whereas small airports will likely have only one person performing the assessment.

Pre-Assessment Tasks

Audits and assessments are demanding exercises. They are labor intensive and can be very disruptive to the normal operation of the airport/department being assessed if not properly planned. Preparation before the site visit will mitigate any undue stress on those being assessed and greatly enhance the possibility of successfully achieving the assessment objectives.

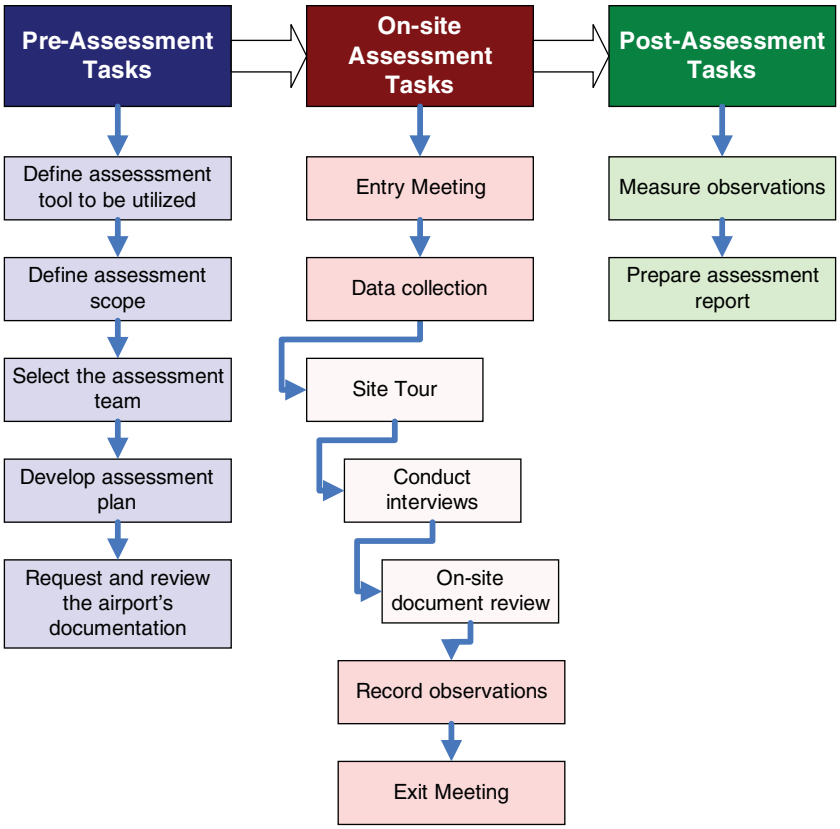


Figure 19. Generic assessment protocol.

Pre-assessment tasks may include the definition of the assessment team, preparation of an assessment plan, selection or development of an assessment checklist, notifying the unit to be assessed, organizing and scheduling the visit, requesting and reviewing key documentation, identifying key staff and scheduling interviews, and other such activities.

Define the Assessment Tool

SMS evaluations are performance-based, and this means that both the process and the end result are important to achieve the safety objectives; therefore, different airports may have different processes to achieve their safety goals. While the principles and elements of SMS do not change, the structure and way in which these elements are arranged to provide a framework may vary. The same is true with the airport units and the procedures and resources they use to carry out their activities.

Whether an SMS regulatory framework is in place or not, the purpose of an SMS assessment is to ensure that all the elements that define an SMS and their associated processes are in place, functioning effectively, documented, being practiced, and support management objectives. The idea is to review all operational processes of SMS and assess them against the pillars and elements of the framework. Once that has been done, you can determine whether the processes are achieving their objectives and identify where improvements may be needed.

For internal safety assessments, the process should be tailored to the airport unit subject to the assessment. A checklist to assess the ARFF unit is different from the one used for maintenance or an airport tenant.

Determine Assessment Scope

Depending on how you approach this exercise, the scope of the assessment may vary widely. At this stage, you have to define the parameters that will govern the assessment. The scope definition should cover the following at a minimum:

- Geographic extent of the assessment (e.g., Apron C, whole airside, Parking Garage B)
- Business unit being assessed
- Time period
- Assessment topics (e.g., assessment of the SRM process, training, equipment)
- Level and depth of detail of the assessment

Select Assessment Team

The scope of the assessment will determine the number and qualifications of the personnel assigned as assessment team members.

It is not necessary that all team members have the same qualifications, but it is important that, as a team, they are able to cover all the technical expertise and experience needed to perform the job effectively and efficiently. For example, the team conducting an assessment of the airport ARFF unit should have at least one member with experience in ARFF. In addition, it is recommended that team members are free of any potential conflict of interest.

At the very least, the assessment team as a whole should have audit or assessment experience, technical expertise in the functional area being assessed, and knowledge and experience with SMS. When the team includes more than one member, a team leader should be appointed as the single point of contact for the team.

If your airport has an internal audit group or function, you should consider their support, either to help you develop an assessment protocol and/or to assist with data collection and analysis.

Develop Assessment Plan

The assessment plan is the master document that will lay out the activities, requirements, and details of the assessment process. It should include the following at a minimum:

- An introduction defining the purpose and the scope of the assessment
- Tentative dates and locations of the assessment
- A description of the assessment methodology and approach
- A detailed schedule of planned activities
- Members of the team, including their roles and responsibilities
- Logistic requirements

This plan should be developed and presented to those being assessed in advance of the assessment itself. The planning and pre-arranged logistics will ensure that the normally limited time available for the on-site visit is used efficiently.

Request and Review Documents

The assessment process should begin well in advance of setting foot in the facilities of the department being assessed. Significant information can be obtained through the review of existing documentation before the visit, such as information on existing processes and practices and what is, or more important, what is not documented. It will also help, in the case of a stakeholder

assessment, to familiarize the team with the operations and the organizational structure of the unit or department and assist in selecting key people to interview. The following are some examples of typical documents that would be helpful to review:

- SMS policy statement
- Certificates/permits/approvals
- Hazard identification records
- Procedures and practices
- Past assessment/incident reports
- SMS documentation such as the SMS Manual, hazard log, accident investigations
- Organization charts
- Performance indicators and trend analysis
- Training records (for internal safety assessments only)
- Equipment maintenance records (for internal safety assessments only)

On-Site Assessment Tasks

All tasks performed during this phase will help validate processes and procedures included in the documentation reviewed, establish a rapport with personnel from the department being assessed, and provide a deeper insight into the airport/department being assessed.

Entry Meeting

This is meant to be a brief introductory meeting to further expand on the details presented in the assessment plan, clarify specific points about the methodology and the scope of the process, and confirm all logistic requirements.

Data Collection

Site Tour. The first task the assessment team should perform once on-site is a physical tour of the facilities. This allows for a firsthand view of the operation, a direct observation of the practices used by staff in the field, and the general condition of the infrastructure, equipment, and work conditions available. It will also help identify potential interviewees and assist the assessment team in starting to set up a list of sample questions.

Interviews. Interviews provide a fertile and dynamic setting for the gathering of information. Unlike the document review or the site tour, which can provide only a snapshot of the information presented, interviews allow for follow-up questions and interaction to better clarify issues.

As with every other skill, performing interviews effectively requires training and practice. The following tips provide an overview of the key activities associated with this task:

- Identify the SMS and safety elements to be addressed
- Identify potential issues
- Record notes in bullet form, concentrating on key facts
- Keep a record of items to follow up on later
- Ask open-ended questions
- Conduct the interview in a location where the interviewee will be comfortable (e.g., their place of work)

The key to effective interviewing is to spend more time listening than talking. Your goal is not to fill out a form but to elicit essential information that will help your SMS assessment.

On-Site Documentation Review. As the assessment team gathers information, other documentation will emerge that was either unknown at the time of the pre-assessment review or impractical to be made available at that time. The assessment team should collect and review this information as it becomes accessible. The type of documentation that might emerge could include the following:

- Internal documentation detailing management and other responsibilities
- Control mechanisms
- Information management
- Training and awareness programs and records
- Permits, approvals, licenses, and exemptions
- Contracts and specifications
- Maintenance records
- Specific operating procedures

Record Observations

As the assessment progresses, the information collected must be recorded and organized in a manner that is relevant to management and easy to cross reference with the assessment checklist. An effective guideline to ensure that the observations stated are credible and clear should at least include the following steps:

- Describe the situation (SETTING): The setting is a description of the circumstances through which the information was gathered.
- Identify the requirement (CONDITION EXPECTED): The condition expected is the assessment team's expectations of the item being assessed.
- Describe objective evidence (CONDITION FOUND): The condition found is the actual observation and must be stated in a factual manner that is clear and precise yet conveys the full extent of the situation including instances when best practices were demonstrated. It must be supported with the appropriate data (e.g., document or interview reference).
- Cite the reference to the standard (REQUIREMENT): The requirement is the airport policy, best management practice, the airport's rules and regulations, or other citation reference. This must be included in every observation.

The assessment team members should be encouraged to review and organize their notes as soon as possible after completing an interview or site visit. It is easy to lose track of insights and observations after only a few days.

Exit Meeting

The exit meeting provides a summary of what took place during the assessment. Its purpose is to conclude the activities of the assessment, present airport or department managers with a summary of the principal observations gathered during the assessment, and provide an opportunity for management to discuss and clarify any potential discrepancies.

Post-Assessment Tasks

This phase of the assessment seeks to formalize the process into a deliverable. Depending on the initial scope of the assessment, this phase will conclude the assessment of the airport or targeted unit.

Measure Observations and Provide Assessment

With all the information on hand, it is now time to provide a more accurate and detailed judgment of the assessment, supported by the observations made throughout the assessment process. Regardless of the tools used during the exercise, the purpose of an assessment is to validate measures put in place to achieve successful and safe operations, and to determine their effectiveness and efficiency. In other words, the assessment has to provide answers to the following questions:

- **Existence:** Have the measures developed by management been implemented, and to what degree are those measures being used and applied?
- **Efficiency:** Are the measures providing the best possible results/benefits for the level of effort/resources exerted to support them?
- **Effectiveness:** Do those measures support the objectives set up by management with regard to SMS and safety?

While most of the answers to these questions are judgment based and rely heavily on the assessment team's experience and knowledge of SMS and safety, there are tools available to support less experienced assessors. An example of a simple tool for SMS assessment is one that breaks down the SMS framework by pillars, elements, and expectations. A random scale can be used to allow for comparison of different elements. An evaluation of independent expectations defines the scoring for each element. The scores for all elements are then added to score each pillar, then all pillar scores are added to provide an overall SMS score. The use of such a tool is described in Annex B of this guidebook.

Develop Assessment Report

The assessment report is the final task of the process and documents the overall assessment. It also identifies the strengths and weaknesses of the airport/department's practices, procedures, and available resources in support of the SMS and safety objectives.

The report does not need to be formal. It should indicate to the airport management and Accountable Executive those deficiencies identified during the assessment process so that corrective actions can be taken. This document may include the following:

- An executive summary of the observations
- Date of assessment and assessment period
- Team members
- Objectives and scope
- Assessment expectations/criteria
- Summary of assessment process (i.e., sampling and assessment plan)
- Details of observations
- Results of the assessment
- Recommendations for corrective actions
- A list of documents reviewed

The final assessment report usually is prepared by the team leader, with input from the assessment team.

SMS Assessments

SMS Assessment Tables

SMS assessments are similar to the gap analysis process, in that they both examine and evaluate the SMS elements. But whereas gap analysis is done before the SMS is in place, to check what is available, what is missing, and what needs to be adapted, the SMS assessment looks at the in-place SMS elements to determine how effectively they are functioning and to rate them for per-

formance. Moreover, the assessment may look only at individual elements of the SMS or even individual units of the airport to check how well they are performing their SMS roles and tasks.

SMS assessment tables are available in Annex A. The assessment tables are designed to organize and consolidate the information and observations collected during an SMS assessment.

How to Use

The worksheets are a series of tables that contain all of the expectations associated with each SMS pillar and element. There is space for the assessment team to record information references, score, and observations (justification for the given score). The tables shown in Annex A are organized as follows:

- The first column contains SMS expectations
- The second column is for describing the references—the source of observations or information collected during the document review or interviews
- The third column is for the score assigned to each expectation—the scoring methodology is described in the following SMS Scoring Methodology section
- The fourth column is for the observations/information collected by the assessment team that justify the assigned score

References

During the assessment, team members should collect as much information as possible to use as references to support their observations, including the name, position, and department of the person being interviewed; the observation location and time; and the document title, publication date, and reference number. If the expectations worksheets are going to be part of the final deliverable to the client, a complete reference may not appear in the final version to protect the privacy of individuals. However, this information should be available to the assessment team during the scoring process and for future reference, if required.

Scoring

Scoring should be conducted by all members of the assessment team according to the methodology outlined below. Pillar and element scoring should be done after all of the team member's observations have been recorded on the worksheet.

Observations

All members of the assessment team should transfer their observations from their notebooks to the worksheets and score each expectation. There need only be one working copy of this document, which is passed between team members. This may be done at the end of each day of the site visit.

SMS Scoring Methodology

One possible alternative to quantify the assessment is presented in this section. Once all of the observations have been recorded, the team should collectively score the SMS elements. There should be a consensus on the score assigned to each element. In the event that there is a disagreement, the team leader will make the final decision. The following criteria should be used.

1. Score Expectations

   Expectations are given a score (see no. 2, Score Elements) based on the information collected during assessment to remove subjectivity. The score may have one or more comments associated with it that provide justification and context.

   Expectations may be scored by individual team members. Another team member may override the initial score if the information required to justify a change is provided.

   Team members should come to a consensus on the score assigned to each expectation.

2. Score Elements

   The assigned score is not based on a mathematical average of the expectations scores; rather, expectations scores serve as a guide for pillar and element scoring.

   Sub-elements and elements are given a score of 0 through 4 as follows:

   "0" is given when none of the expectations under the element are met (comments/justification required)

   "1" is given when some of the expectations under the element are met (comments/justification required)

   "2" is given when all expectations under the element are met (no comment required)

   "3" is given when all of the expectations are met or exceeded (comments/justification required)

   "3+" may be assigned if the assessment team feels that the organizational unit has done an exceptional job, meeting or exceeding all of the expectations under this element, and deserves extra mention (comments/justification required)

   "4" is given in the event that the organization exhibits a best practice for this element (rare, extremely subjective, and may only be assigned by an SMS expert with particular industry experience [comments/justification required])

   Add the sub-element scores to assign element scores, as required. Again, the score is not based on a mathematical average; the sub-element scores serve as a guide for the element scores.

   Elements can only be assigned whole numbers; no decimals.

   All team members should agree on the element scores before assigning pillar scores.

   Element scores should be recorded on the scoring table presented in Annex C.

3. Add to Score SMS Pillars

   Pillars are scored last, following a similar process to element scoring.

   The assigned score is not based on a mathematical average of the element scores. Element scoring serves as a guide for pillar scoring.

   Pillars are given a score of 0 through 4, following the same criteria used for the sub-element scores.

   Pillars can only be assigned whole numbers.

   All team members should agree on the final pillar scores.

   Pillar scores should be recorded on the scoring table presented in Annex C.

Internal Safety Assessments

SMS is a systematic approach to managing safety risks within an organization. SMS achieves this objective by establishing a series of processes and procedures that, once developed and implemented, will help an organization identify and address potential risks in relevant areas. One of the most effective processes at your disposal for this purpose is the internal safety assessment (some organizations prefer the terminology internal safety audit). Since we are trying to take an inward look at airport safety performance, we will use the term internal safety assessment even when it is applied to an airport tenant.

Essentially, this process helps departmental and divisional leaders be self-critical and, ultimately, will help make their department/division as safe as possible. When these safety assessments are performed in a different organization working at the airport, there needs to be an agreement between the airport and the stakeholder or clause in the lease contract because there is currently no regulatory basis for the procedure.

The internal safety assessment process can be used by both senior managers and department/division directors and managers to ensure that the area for which they are responsible is as safe as possible and/or to identify specific deficiencies.

Airports are very complex environments. They differ greatly depending on the size and type of operation. Their risks and "safety status" or "safety health" will also vary depending on things such as their safety culture, level of maturity of the SMS, organizational structure, and management style; however, there are common functional areas that should be targeted during an internal safety assessment.

There are many different theoretical and conceptual models that provide different methods for performing self-assessments/audits. In this section, key functional areas are presented that affect safety. Managers and directors should consider these when evaluating their departments and divisions for safety.

Ideally, the airport should develop specific checklists to assess each of these areas. These checklists can be continuously improved as more safety assessments are performed on a regular basis. Each subsection presented is not meant to provide an exhaustive list of questions that can be asked when performing an internal self-assessment. They are meant to provide general guidance for department and division managers and directors who may perform these assessments.

Safety Management System

This area concerns your department/division performance with respect to SMS. This part of the assessment can be completed by using the tools provided in this section that concern SMS assessment for the whole organization. Some questions to ask in addition to those provided in the SMS assessment subsection are as follows:

- Has my department/division established the appropriate SMS processes?
- How often does my department/division use these processes?
- Have I assessed all the regulatory standards and regulations that affect me?
- Has my department/division established objectives in line with those of the organization?

Staff

This area concerns the people who work within the organizational unit being assessed. These are the human resources that do the work and ensure the unit accomplishes what it needs to do. There are three major functional areas you need to assess to determine safety: competency, job satisfaction, and safety culture. Some questions you can ask yourself are:

- Have all my employees received the training they need? Is this training adequate?
- What is the turnover in my department/division?
- Do employees use/follow operating procedures?
- How many grievances have been filed in a given period of time?
- Do employees understand the organizationwide safety initiatives?
- Do they understand their safety roles in the unit and in the airport organization?
- Are they motivated to do their jobs, and do they care about safety?

Assets

This area concerns the equipment and materials used by the unit. The availability and status of equipment and material play a very important role in safety. The equipment may serve as a control for preventing an accident or incident; however, if it lacks proper design, calibration,

maintenance, or use, the equipment may fail and be the cause of an accident or incident. Questions to ask include the following:

- Is your staff appropriately trained in the use of the equipment/tools they are provided?
- Are all of your assets being properly maintained? How do you know?
- Do you have standards to determine the required equipment specifications?
- Can your people use your assets while wearing PPE?
- Is the quantity of material and equipment appropriate for the size of your operations?
- How do you deal with equipment breakdown? Do you have a backup?

Environment

This area deals with the working environment in which your department/division operates. Temperature, lighting, space allocation, outdoors versus indoors, and so on can be considered. Essentially, you want to ensure that the environment does not lead to accidents. The following are questions to consider:

- Does it ever get too hot or too cold? Has this led to human error or equipment failure?
- Are rain/snow storms considered in your procedures?
- Is there adequate lighting?
- Do your people always have enough space to do their work safely?
- Do you have specific procedures for unfavorable weather conditions (e.g., strong winds, low visibility, rain/snow, lightning, winter operations)?

Organization

The unit organization and its place in the airport organizational structure are very important. This organization provides, among other things, the overarching policies, programs, and systems to which you must subscribe, and controls the allocation of resources your department/division receives. The unit must operate within this larger organization effectively to achieve a high level of safety. Some questions to ask are as follows:

- Have there been any major organizational changes that may affect your department/division?
- Does your department/division have the resources it needs (financial, human, asset)?
- Do you have access to higher levels of management to elevate safety issues?
- Do you have a positive and cooperative relationship with the regulatory authorities?

Occupational Safety and Health

This area deals with conventional occupational safety and health matters. While SMS focuses mainly on airport activities, departmental/divisional managers or directors must concern themselves with safety as a whole. This subject is well documented and regulated worldwide, and many assessment tools exist. Some questions to consider are as follows:

- Does my department/division have adequate PPE? Is it used properly?
- Has my department/division received all the necessary training related to occupational safety and health?
- Do personnel practice lockout-tagout?
- Do personnel perform regular housekeeping inspections?

Airport Tenants and Contractors

This area deals with airport tenants and contractors and their effect on airport safety. Airport stakeholders play a large role in the operations of every airport and, as such, must be taken into account when assessing the safety of any department/division. Again, there needs to be an

agreement between the airport and the stakeholder to permit a safety assessment of the stakeholder unit at the airport. Some questions to consider might include the following:

- Are there provisions in leases/operational agreements to ensure the management of safety issues?
- Do stakeholders follow airport rules, regulations, and procedures?
- Do they keep safety records? Are they complete, accurate, and used to track progress? How well are they performing?
- Do they participate in airport safety meetings? Do they have their own safety meetings?
- Do their service providers have specific safety training?
- Do they report accidents and incidents?
- Are their employees aware of how to report safety issues?
- Do they have appropriate resources to operate?
- Is their equipment well maintained?

Interfaces

In this context, an interface is the boundary between two (or more) of the functional areas where they interact. Some of these interfaces are readily apparent in some of the previous questions, for example:

- Can your staff use your assets while wearing PPE? This is an example of the interface between occupational safety and health, assets, and people.
- Do the procedures that they use apply to all weather conditions?
- Is their training program aligned with the department needs?
- Do their current schedules provide for supervision during all shift work?

6.7 Measuring SMS Performance—Trend Analysis

Importance of Trend Analysis

The causal factors of accidents and incidents, and the effectiveness of corrective actions at an airport can be fully understood and evaluated only if their frequency and distribution are examined in terms of type of event, location, and conditions. Trend analysis is one leg of this analytic triangle. It is used for hazard surveillance and monitoring, forecasting, program evaluation, policy analysis, and the investigation of potential causal relationships between risk factors and outcomes. Trend analysis is used for the following objectives:

- To identify the overall pattern of change in a safety performance indicator over time (increase or decrease, rate of change)
- To compare one time period with another (effectiveness of operations before versus after a risk control action or the implementation of new regulations)
- To compare different airport areas or seasonal differences (level of safety for Apron A and Apron B; accident rates in summer versus winter)
- To compare two or more groups (trained versus untrained, different service providers)
- To make future projections (monitor progress toward a safety objective; provide an estimate of the rate of future occurrence)

What Is Trend Analysis?

Trend analysis looks for changes in safety levels over a given time period (e.g., the last 12 months). The safety level is usually measured using key performance indicators selected by the airport.

If the airport wants to measure the level of safety at the ramp, a simple safety performance indicator in this case may be the number of accidents that have occurred on the ramp in any given month. Checking if the number of accidents is increasing or decreasing over the months is trend analysis.

The objective of trend analysis is to

- Determine the "safety health" state of the airport,
- Identify trends in safety levels, and
- Identify needs and determine actions required to maintain and/or improve safety.

Analyze trends to determine if things are getting better, getting worse, or staying the same.

Management could have set a goal to reduce ramp incidents by 20%. This statement is appropriate at the organizational level, but before ramp operations can act on it in a meaningful way, it needs to identify at least two things: (1) the baseline (i.e., how many incidents are occurring now) and (2) which activities are having an effect on apron incidents (passenger bridge, service equipment-aircraft, vehicle-vehicle, etc.). This knowledge comes from trend analysis.

If you do not have the necessary data, set up a method (as part of your reporting system) that will allow you to collect data relevant to those activities. Once you start collecting the data, you will know how many incidents are occurring. You can then set a baseline against which you can compare future performance.

You should be careful when using the raw number of accidents or incidents to verify trends. The number of undesirable events is related to the number of operations and a drop in the number of incidents may be a consequence of a decrease in activity level. You may prefer to use accident rates instead of the number of accidents. An accident rate is the number of accidents divided by a fixed number of operations over a period (e.g., 10,000 operations in 1 year). A decrease in the rate of accidents is a clear and reliable picture of safety improvements at your airport.

Analysis of the data collected should allow you to identify which activities have the most impact in the incident count. This information should help you focus on the major problems and develop action plans to reduce them. At the same time, it will allow you to track whether these plans are effective.

Assume that the data collected show that, after 6 months, bridge-aircraft incidents add up to eight events. After analysis and investigation, you decide that implementation of a stricter training program and spot checks should improve airline employees' skills and compliance with the rules, thus reducing the number of bridge-aircraft incidents. Six months later, when you do your next review, you should be able to see if the number of incidents has gone up or down. If the number of incidents has not decreased, additional actions will be required (e.g., intensifying supervision and enforcement of SOPs) to mitigate the likelihood of more incidents.

Measurements must focus on factors that are related to overall safety objectives. Most important, measurements must be related to the most significant risk contributors. Although performance measurements include incident statistics, they are primarily intended to be proactive (i.e., identify problems before an accident occurs).

Some representative performance indicators can be as follows:

- Number of airside vehicle operation infractions per month
- Number of FOD reports
- Number of bird strikes
- Number of runway incursions
- Percentage of employees with basic SMS training

Collecting information on the number of violations should be done carefully to avoid bias. If you do not have enforcement officers on the ramp, the numbers may actually go down, even when more incidents occur.

For larger airports, performance indicators may be related to specific areas of the airport, for example:

- Number of airside vehicle operations infractions per month on Apron C
- Number of runway incursions at a specific "hot spot"

Data Considerations

For SMS, most trend analysis data are related to the key safety performance indicators selected for monitoring. The airport needs to make sure the data quality objectives are met. Trend analysis requires strict monitoring protocols. If the airport wants to determine the trends for apron accidents, it should make sure reliable data are gathered every month over a significant period (e.g., 3 to 5 years).

It is essential to identify the audience and the type of analysis or presentation appropriate for that audience. For example, if it is necessary to report the trends to raise safety awareness at the ramp, the audience will be every person working on the ramp. In this case, the message should be very simple.

Determining the cause of a trend is more difficult than determining the trend, but it is the critical element for defining effective corrective actions. To identify causal factors for certain trends, it is necessary to consider all the exogenous parameters that can influence those trends (volume of traffic, environmental conditions, time of day, etc.).

The following are some important issues to consider when developing a trend analysis:

- Consistent data quality—Trend analysis assumes that the same or equivalent methods and protocols are used for all the monitoring.
- Time frame and number of samples—5 years of monthly data for accident and incident trend analysis; for step trends, at least 2 years of monthly data before and after a major change (e.g., new SOP, change in personnel, application of a corrective action, change in organization).
- Seasonality—Parameters that vary naturally in different seasons of the year may require special statistics (e.g., certain types of birds can be more frequent in specific months of the year; apron accidents are more prone to occur under low visibility conditions).

- Statistical significance of a trend—It is common to observe upward or downward trends that simply occur by chance (see an example in Figure 22). This is particularly frequent for performance measurements over small periods or associated with low incidence events (e.g., number of runway incursions). The best way to check if the trend is real or is simply random variation is to set longer periods for evaluation to collect more data and use statistical techniques to check if the differences are statistically significant.

Gathering Data

After the airport safety objectives and goals are set, it is necessary to define the safety performance indicators that will be used to measure performance and check if the objectives are being met. Trend analysis is based on quantitative information collected for these performance indicators (e.g., number of incidents at the ramp, number of bird strikes). The airport operator who records each of these accidents will have a number for each month over a period of a few years.

Other sources of data available for trend analysis are conclusions from accident/incident reports. The root causes identified in the investigations can provide valuable information on specific safety issues that should be addressed by the airport.

Data collection is a critical activity for trend analysis. It is recommended that a written procedure be established to define who will collect the data, the means for collection, specific procedures, and who will receive the information.

Table 25 depicts an example of information on safety performance indicators over a 6-year period, and Table 26 shows an example of data gathered on the number of bird strikes in each month. Table 27 contains the number of job-related injuries at the ramp and the number of operations at the airport during 9 months.

Very small operators may not generate enough data to allow for the monitoring of any trends. In these cases, a possible alternative is to look at the industry as a whole to help identify possible trends. Reviews of accident reports, articles in trade magazines, discussions with industry groups, participation in industry associations, and other operators can provide useful data.

Table 25. Number of ramp accidents (example).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2003	3	0	5	4	1	2	7	1	2	0	3	1	**29**
2004	1	4	2	2	1	5	6	4	0	2	1	4	**32**
2005	2	0	1	1	0	2	4	1	2	0	2	1	**16**
2006	0	1	2	1	0	0	3	1	0	2	0	1	**11**
2007	1	0	0	1	0	1	2	0	0	1	1	1	**8**
2008	0	0	1	0	1	0	2	0	0	0	1	0	**5**

Table 26. Number of bird strikes (example).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2003	0	1	2	0	3	0	2	2	1	3	1	2	**17**
2004	1	0	3	0	0	1	1	2	0	2	1	1	**12**
2005	0	0	1	0	2	0	0	0	1	0	1	0	**5**
2006	1	0	0	2	1	1	0	1	0	1	0	0	**7**
2007	0	2	0	1	2	0	2	0	1	0	1	1	**10**
2008	1	0	2	0	1	1	0	0	3	1	2	0	**11**

Table 27. Number of job-related injuries at the ramp.

Month	Total Number of People Injured	Total Number of Aircraft Operations	Rate of Injuries per 10,000 operations
Jan	6	6648	9.03
Feb	5	5180	9.65
Mar	4	4895	8.17
Apr	3	3650	8.22
May	4	5055	7.91
Jun	5	6230	8.03
Jul	6	8350	7.19
Aug	7	10640	6.58
Sep	8	10910	7.33

Measuring Trends

There are two methods to determine trends: visual and statistical. As shown in Figure 20, graphing or mapping data for people to see is the easiest way to communicate trends, especially to a non-technical crowd; however, this method does not allow one to "measure" that there is a trend or how big it is. Even when a statistical analysis is performed, it should start with the visual assessment of trends.

Another example is depicted in Figure 21. In this example, the root causes of runway incursions by type of vehicle over a period of 1 year are counted. It can be noted that the operation of emergency/snow removal vehicles was the main activity associated with runway incursions, and the airport should take actions to provide additional training to those drivers. In addition, based on the high frequency of incidents associated with communication procedures, the airport may decide to provide additional training on radio communication, replace existing equipment, and establish procedures for escorting contractors.

The statistical method, on the other hand, can identify hard-to-see trends and can give a number that is defensible and repeatable; however, such methods can be difficult and challenging to apply. A statistical analysis is best performed by a qualified person.

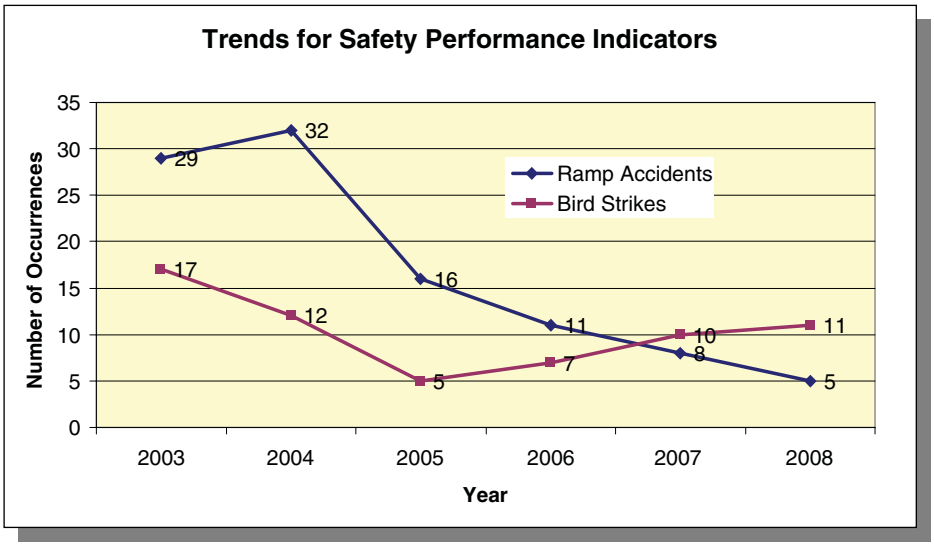


Figure 20. Plotting for visual analysis (example).

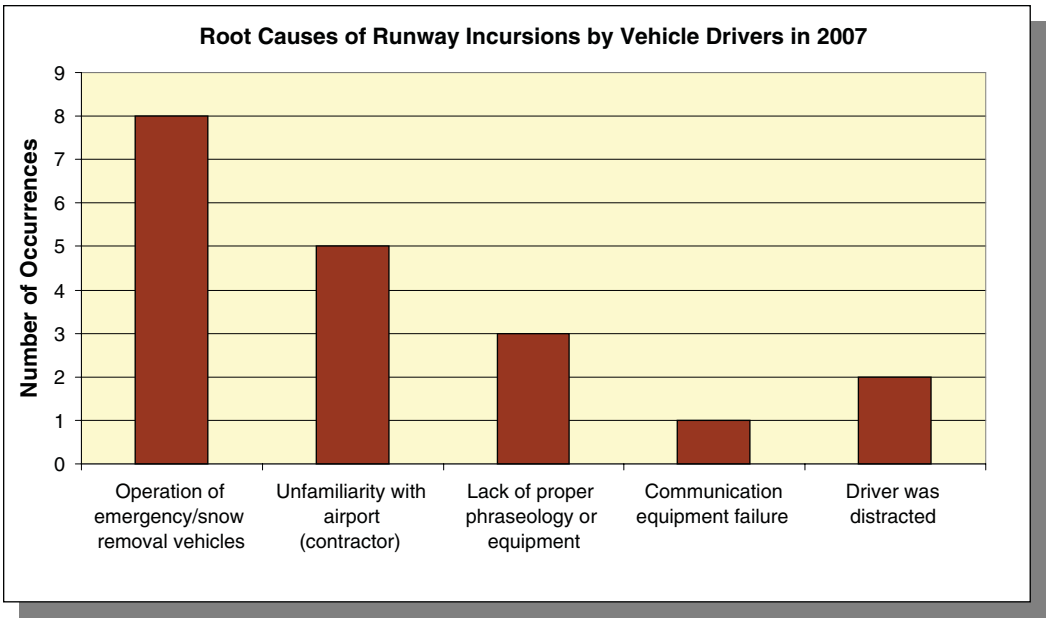


Figure 21. Runway incursions in 2007 (example).

For most cases, a visual analysis with some very simple statistical measuring will be sufficient for evaluating most safety performance indicators used in airport SMS.

Plotting and Smoothing

Spreadsheet software like Microsoft® Excel can be used to plot information on safety performance gathered by the airport. Usually, the information is plotted over the period that the data were collected, sometimes called time series. When evaluating plots, care must be exercised regarding the following issues:

- People tend to focus on the extreme values and not on more subtle changes
- Gradual trends are hard to detect by visual analysis
- Seasonal variation and exogenous variables can mask trends in a parameter
- Viewers can "see what they want to see" sometimes
- Finding no trend may only mean the data were insufficient or the type of plot was inappropriate

Using the example data for bird strikes in Table 26, the plot in Figure 22 can be generated.

Obviously, it is very difficult to state any conclusions from this plot. However, by using the average number of bird strikes for the last 12 months instead of using the raw number of bird strikes in any given month, a trend may become more evident.

Moving averages can be used to smooth out short-term fluctuations, thus highlighting longer-term trends or cycles. The threshold between short term and long term depends on the factor being analyzed, and the parameters of the moving average should be set accordingly.

For the previous example, the average number of bird strikes for Jan 2003 is computed by averaging the results from Feb 2002 to Jan 2003. For Feb 2003, the value is the average from Mar 2002 to Feb 2003, and so on. Note that there are no data for the first 11 months simply because there is no information available to compute the average for the past 12 months. The resulting

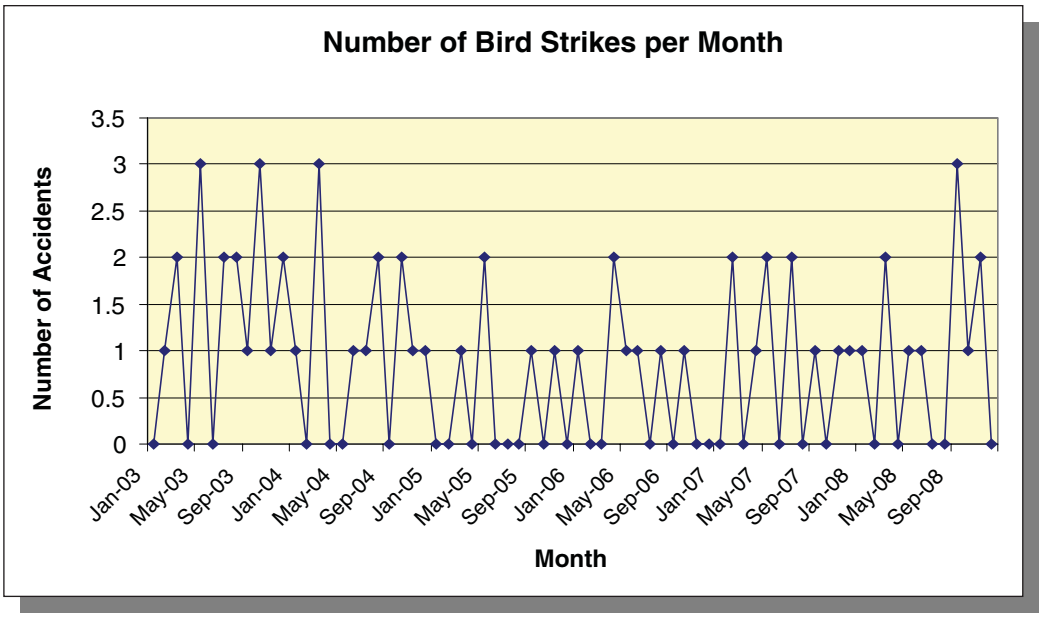


Figure 22. Number of bird strikes per month.

trend for bird strike data is depicted in Figure 23. In this case, the frequency of bird strikes was decreasing until the beginning of 2006, when it started to increase.

Using Accident and Incident Rates

The examples presented so far have used raw data only. However raw data can sometimes be misleading because the number of accidents and incidents tends to have a relationship with the volume of operations or the intensity of activities.

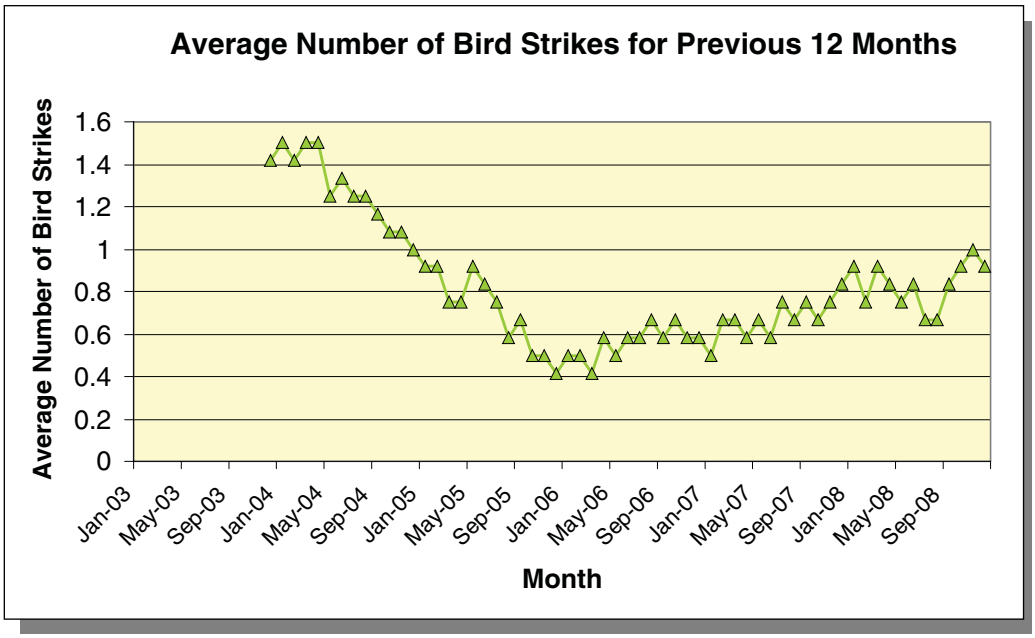


Figure 23. Bird strikes trend using a 12-month moving average.

The example data given in Table 27 puts the problem in perspective and helps your understanding. As noted in that table, the number of job-related injuries at the ramp dropped from January to May; and after June the numbers started to rise. The trend is shown in Figure 24.

However, the volume of operations changed significantly during this period. One can expect to have a higher number of accidents if more operations are carried out at the airport. If, instead of raw numbers, the rate of accidents per 10,000 operations is used, a different trend can be observed.

The rate can be calculated using the number of accidents in a given month and the number of aircraft operations for that same period, using the following equation:

$$AccRate = TNAcc \times 10{,}000/TNOps$$

Where:

AccRate is the rate of accidents per 10,000 operations
TNAcc is the total number of accidents in a given period
TNOps is the total number of aircraft operations during the same period

For example, using the data from Table 27, in January:

$$AccRate = 6 \times 10{,}000/6{,}648 = 9.03 \text{ injuries per } 10{,}000 \text{ operations}$$

The fourth column in Table 27 depicts the accidents rates for the example data provided. When plotting the accident rates, instead of the raw data, the trend shown in Figure 25 is observed; the rate is clearly decreasing.

Trend Analysis Reports

As a minimum, the following information should be reported for each trend analysis:

- Display plots of the observed data over time
- Comments in narrative form on the stability of the rates and approaches used to improve it
- Report average percent change for periods when the rate is fairly constant
- Interpret in narrative form the trend and how it relates to achieving the safety objectives of the airport

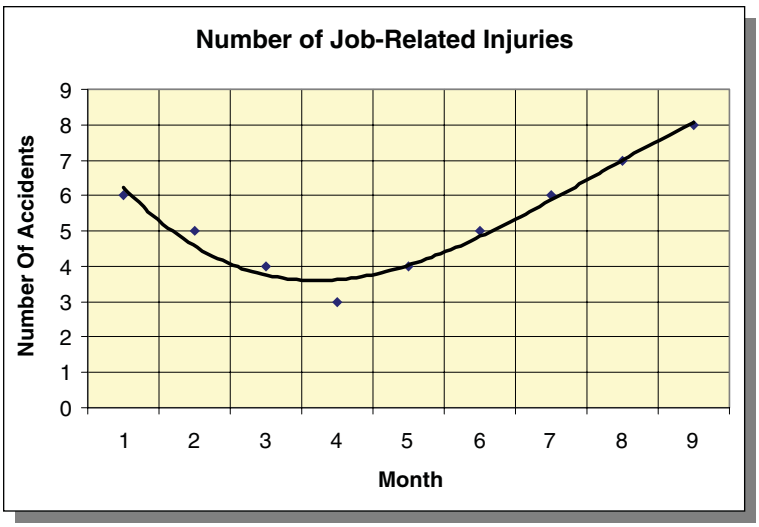


Figure 24. Trend for job-related injuries at the ramp.

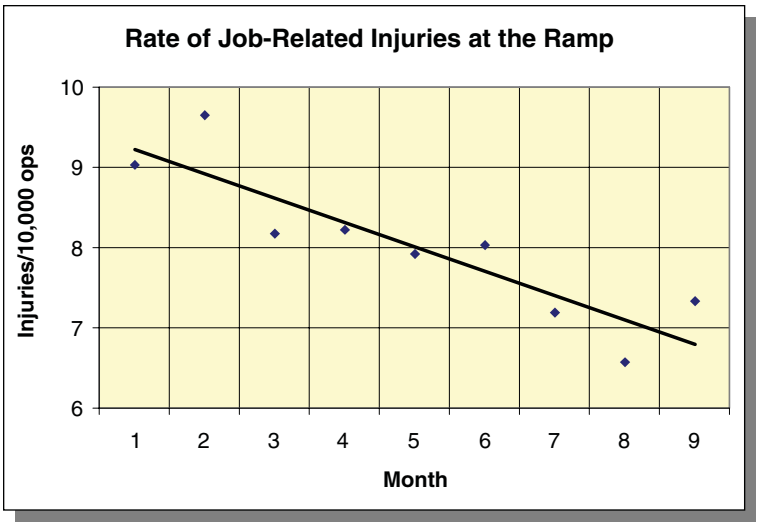


Figure 25. Rate of job-related injuries per 10,000 operations at the ramp.

In addition, always attempt to identify any factors causing the trend. The analysis is more convincing if it demonstrates that apparent trends can be explained by plausible relationships with other factors. For example, if using the example data depicted in Table 25 and plotting the average number of accidents on the apron for each month over a 6-year period, the bar chart depicted in Figure 26 can be developed.

The figure suggests the number of accidents is higher for July. Causes could be related to the increase in operations, or to the frequency of low visibility conditions, or to both factors.

6.8 Safety Training and Education

Your airport needs to establish and provide a training program to staff to maintain excellent safety levels. This may apply to general work functions and SMS functions. It may also apply to

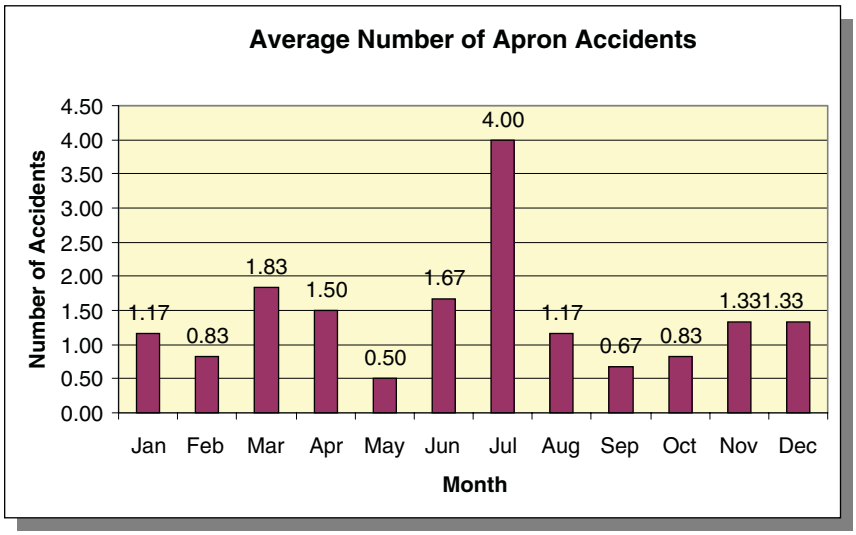


Figure 26. Monthly average of apron accidents.

contractors and service providers who need to be aware of at least a minimum level of airport SMS requirements and emergency procedures. Moreover, safety training and education are essential elements in creating a positive safety culture within the airport organization, which is vital to the operation of an effective SMS.

All employees must have the skills and competencies necessary to perform their duties in an effective and safe manner. In addition to safety skills training, airport workers need to be aware of their SMS roles, safety responsibilities, and how they can cooperate to bring about a safety system that works. Some key players, like the SMS Manager, may need to develop their capacity to manage and run the SMS processes.

Safety training should begin with the initial indoctrination of employees and continue throughout the duration of their employment. Specific safety management training should be provided for staff occupying positions with particular safety responsibilities. The training program should ensure that the safety policy and principles of the organization are understood and adhered to by all staff.

According to AC 150/5200-37[1], safety training and education should consist of the following:

- A documented process to identify training requirements
- A validation process that measures the effectiveness of training
- Initial (general safety) job-specific training
- Recurrent safety training
- Indoctrination and initial training incorporating SMS
- Training that includes human factors and organizational factors

Currently, training programs are administered by individual airports and safety training is focused on 14 CFR Part 139 requirements, which at this point does not address SMS. This section of the guidebook describes a systemic approach to safety training and suggests four levels of safety and SMS training programs to cover the needs of different staff levels and SMS functions in the airport organization.

Systemic Approach to Safety Training

Effective training does not just happen; it requires planning and management. Every airport training program should follow a Systems Approach to Training (SAT). The SAT process is depicted in Figure 27 and includes the activities described below.

- **Needs Analysis:** Identify the jobs and the tasks associated with each position and determine the related knowledge and skills required to safely perform those tasks. Moreover, the safety risk management process and the SMS review will also help identify training needs.
- **Design:** Define the training objectives and the methods by which training will be delivered, and design test items and methods to verify whether training objectives have been met.
- **Development:** Establish the sequence and level in which the training topics will be presented, develop lesson plans, develop or assemble training manuals, gather all required training materials, and identify instructors.
- **Instruction:** Prepare instructors, deliver training, and obtain feedback (testing) of participants.
- **Program Evaluation:** Measure the effectiveness of the training program through internal and external evaluation to validate the program and promote identification of areas where improvement might be indicated. Two types of evaluation should take place:
  - — A post-training evaluation questionnaire given to the course participants immediately following the training.
  - — A post-exercise verification of the training retention, conducted no less than 2 weeks after the training and no more than 90 days, through a brief interview with selected participants.

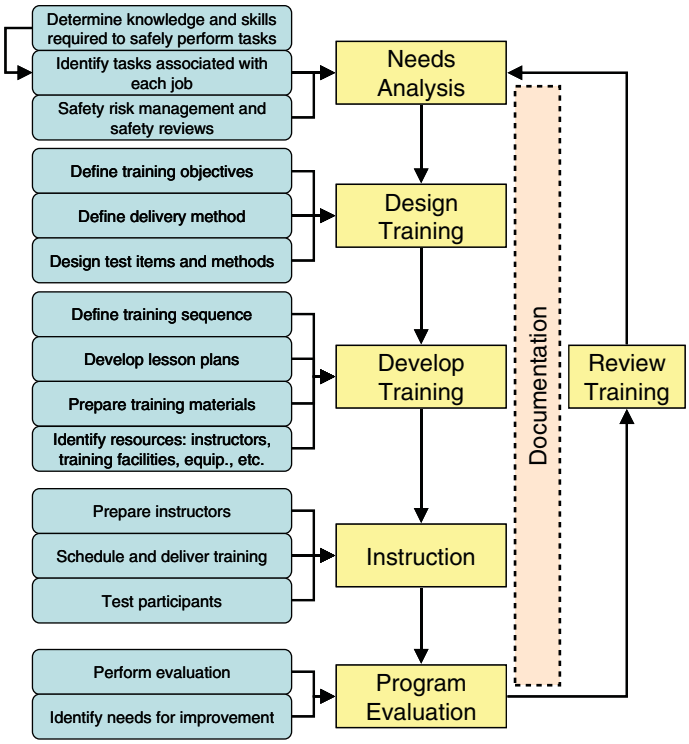


Figure 27. Systemic approach to safety training diagram.

- **Review:** Based on the results obtained during the Program Evaluation phase, revisions and updates to the program should be made;
- **Documentation:** All documentation generated during these processes is managed following the document control and management process.

Training Levels

Under the SMS framework, four types of safety training should be provided to personnel working at the airport: indoctrination training, job-specific training, SMS training for managers and supervisors, and SMS training for staff.

Indoctrination Training

Mandatory and recurrent SMS indoctrination training should be provided to all personnel performing duties at the airport with access to secured areas. This includes personnel from all organizations authorized to operate at the airport such as aircraft operators, fuel providers, catering organizations, ground services companies, FBOs, enforcement agencies, and government organizations.

SMS indoctrination training can be delivered in conjunction with the security identification display areas (SIDA) identification process and prior to the issuance of the access control card. This training delivery can be presented in a classroom setting and include one or more supporting materials, such as pamphlets, introductory briefs, videos, or PowerPoint presentations.

The safety module should include the basic topics given in Table 28 and should be designed for anyone working at the airport.

Table 28. Training program for SMS indoctrination.

Item	Description
Prerequisites:	None
Duration:	30 min to 1 hour
Schedule:	Offered regularly, as required
Intended for:	All new airport employees and personnel from other organizations authorized to operate at the airport
Topics:	Safety policy and objectives, safety roles and responsibilities, how to report safety issues, familiarization with airport areas, rules and regulations, communication procedures, and general emergency procedures
Testing:	Quiz at the end of the session (pass/fail)

Job-Specific Training

Most categories of airport staff will require additional occupational health and safety training to ensure they can perform their duties in a safe manner. Part of this safety skills training is a statutory requirement and is contained within specific regulations. Other required skills will be identified in the airport's job training needs analysis. Clearly, the specific types of training required for airport staff members working in airport areas will depend on the functions fulfilled by the individual. This program should be customized by the head of each airport department and should be fabricated for the specific needs of each employee. A suggested general program for this training is described in Table 29.

SMS Training for Managers and Supervisors

It is essential that the airport management team understand the principles on which the SMS is based. Training should ensure that airport managers and supervisors be familiar with their roles, responsibilities, and accountability for safety. They should receive training that addresses the legal issues involved and their legal liabilities. Also, managers should know their SMS roles; how to set specific safety goals for their departments/sections; the fundamentals of reactive and proactive hazard identification and safety risk management processes; and how to identify, assess, prioritize, and treat risks in their area of responsibility. A suggested prerequisite for this training is SMS indoctrination because managers and supervisors should be aware of the SMS training their employees are receiving. Table 30 includes a basic training program with the topics that should be covered.

Table 29. Job specific safety training program.

Item	Description
Prerequisites:	SMS indoctrination
Duration:	As required
Location:	On-the-job training (office, field, etc.)
Schedule:	To be completed within the first two weeks of employment
Intended for:	All new airport employees
Topics:	Training aimed at a specific work area: familiarization with the department, description of specific tasks, description of specific procedures, the importance of safety, main hazards and risks on the job, key safety procedures, specific emergency procedures of key safety personnel
Testing:	Overall evaluation by the instructor (pass/fail)

Table 30. SMS training program for managers.

Item	Description
Prerequisites:	SMS indoctrination
Duration:	1 ½ day
Schedule:	Offered as required
Intended for:	Managers and Supervisors
Topics:	SMS legal requirements and regulations; SMS roles and safety responsibilities; procedures for setting policies, objectives and goals; establishing safety performance indicators; safety communication; demonstration of commitment to the airport safety policy; developing SOPs; cascading meeting; how to manage safety risks including hazard identification, risk assessment, prioritization and treatment; management of change; safety culture and promotion; and continuous improvement.
Testing:	Quiz at the end of the course and completion of three hazard identifications and corresponding risk assessments (pass/fail)

SMS Staff Training

To ensure the effectiveness of the SMS program at your airport, those individuals with a direct role in the management of the program will supplement their skills through specific training programs. They include the following:

- SMS concepts
- Safety risk management
- Investigation and root cause analysis techniques
- Reviews, inspections, and audit procedures and techniques
- Data collection and database management
- Trend analysis

It is important that staff performing these tasks receive adequate training in specific methods and techniques. Depending on the depth of training required and the level of existing expertise in safety management within the organization, it may be necessary to obtain assistance from external specialists to provide this training. Table 31 depicts a general training program for this level.

In addition to these four types of safety training, individuals who require key safety skills will need to receive up-to-date refresher training. The frequency should vary according to the degree of the risk, the use of the skills, the rate at which skills can be forgotten, and when any significant

Table 31. Training program for SMS staff.

Item	Description
Prerequisites:	SMS Training for Managers
Duration:	5 days
Schedule:	To be completed during the first 6 weeks of employment
Intended for:	SMS staff
Topics:	Basic safety concepts; SMS pillars and elements; safety risk management; SMS planning, implementation and operation; investigation roles, techniques and procedures; interviewing and surveying techniques; data collection and database management techniques; safety records management; trend analysis
Testing:	Test (passing grade of 80%)

changes to procedures are made. Refresher training should be programmed and recorded when completed.

At small airports, a formal systemic approach to training is not feasible and the process should be simplified. For such cases, it is likely that only one or two airport employees will have a more comprehensive SMS training. Other employees will require only SMS indoctrination training that may be provided on the job by the SMS Manager.

Training Documentation

Records of all training sessions, attendees, test results, and syllabus review and updates should be stored and managed. An employee training record should be maintained for each employee. This may include the following:

- Training completed before joining the airport organization
- Training completed during the employment phase
- Further training programmed or considered desirable

Documentary evidence such as copies of training certificates, college certificates, and the like may be attached or referred to in the training record or maintained in a personnel file.

End Notes

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ANNEX A

Gap Analysis and SMS Assessment Tables

Table 32. SMS assessment table for safety policy and objectives.

1. SAFETY POLICY AND OBJECTIVES			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
1.1 Management commitment and responsibility			
1.1.1 Policy			
1.1.1.1 A safety policy is in place (documented).			
1.1.1.2 The safety policy is approved by top management.			
1.1.1.3 The safety policy is promoted by top management.			
1.1.1.4 The safety policy is reviewed periodically.			
1.1.1.5 There is a policy in place that ensures that employees are free to report safety deficiencies, hazards, or occurrences without being subject to unjust discipline.			
1.1.1.6 The policy includes a commitment to continual improvement.			

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Table 32. (Continued).

1. SAFETY POLICY AND OBJECTIVES			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
1.1.1.7 The policy includes a commitment to comply with applicable legislation and other requirements to which the organization subscribes.			
1.1.1.8 The safety policy is effectively communicated within the organization. Employees are aware of the policy and their SMS obligations.			
1.1.1.9 The safety policy is effectively communicated to external parties including contractors and visitors.			
1.1.1.10 The policy is generally reflected in the safety practices.			
1.1.2 Objectives			
1.1.2.1 Safety objectives are established and documented for each relevant function within the organization.			
1.1.2.2 Safety objectives are publicized and distributed.			
1.1.2.3 A coherent set of safety goals are developed based on objectives.			
1.1.2.4 The results of hazard identification and risk assessments are considered while setting SMS objectives (see 2.1).			
1.1.2.5 Objectives are established consistent with the commitment to continual improvement.			

(continued)

Table 32. (Continued).

1. SAFETY POLICY AND OBJECTIVES			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
1.2 Safety accountabilities of managers			
1.2.1 A top manager is assigned, with responsibility and **accountability** for ensuring that the SMS is properly implemented and performing the requirements in all areas of the organization.			
1.2.2 The top manager accountable for SMS has control of the financial and human resources required for the proper execution of their SMS responsibilities.			
1.3 Appointment of key safety personnel			
1.3.1 A qualified person has been appointed to oversee the implementation and operation of the SMS.			
1.3.2 The safety authority, responsibilities, and accountability of personnel at all levels of the organization are defined and documented.			
1.3.3 The organizational structure facilitates communication between the SMS manager, the top accountable executive, and line managers.			
1.3.4 All those with management responsibility demonstrate their commitment to continual improvement of SMS performance.			
1.3.5 All personnel understand their authority, responsibilities, and accountability in all safety management processes, decisions, and actions.			

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Table 32. (Continued).

1. SAFETY POLICY AND OBJECTIVES			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
1.4 SMS implementation and management			
1.4.1 There is a strategic SMS implementation (or management) plan including assignment of roles and responsibilities, means, and timelines for completion.			
1.4.2 The planning process is conducted at regular, planned intervals by an SMS planning group, which includes the SMS manager.			
1.5 Documentation			
1.5.1 Legal and other requirements			
1.5.1.1 Relevant information on legal and other requirements is communicated to employees and other interested parties.			
1.5.1.2 License and permit requirements are in place and legal requirements implemented.			
1.5.2 SMS Documentation			
1.5.2.1 There is consolidated documentation that describes the SMS and the interrelationships between all its components.			

(continued)

Table 32. (Continued).

1. SAFETY POLICY AND OBJECTIVES		SERVICE PROVIDER	
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
1.5.3 Documentation and data control			
1.5.3.1 Procedures for document control are established.			
1.5.3.2 Documents are periodically reviewed, revised as necessary, and approved by authorized personnel.			
1.5.3.3 Obsolete documents are secure from unintended use and retained documents are identified.			
1.5.3.4 Current versions are available at all relevant locations.			
1.5.4 Record and records management			
1.5.4.1 The airport has a records system that ensures the generation and retention of all records necessary to document and support operational requirements in accordance with applicable regulatory requirements and industry best practices.			
1.5.4.2 The system provides the control processes necessary to ensure appropriate identification, legibility, storage, protection, archiving, retrieval, retention time, and disposition of records.			

Table 33. SMS assessment table for safety risk management.

2. SAFETY RISK MANAGEMENT			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
2.1 Hazard identification			
2.1.1 Hazard identification process			
2.1.1.1 A procedure for the identification of hazards and assessment of risks is established and the methodology is defined.			
2.1.2 Reporting systems			
2.1.2.1 There is a reporting process that is simple and accessible.			
2.1.2.2 Reports are reviewed at the appropriate level of management.			
2.1.2.3 There is a feedback process to notify contributors that their reports have been received and to share the results of the analysis.			
2.1.2.4 All identified hazard data are systematically recorded, stored, and analyzed.			
2.1.2.5 There is a system to share significant safety event information with other similar organizations, subject to reasonable restriction on proprietary and confidential information.			

(continued)

Table 33. (Continued).

2. SAFETY RISK MANAGEMENT		SERVICE PROVIDER	
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
2.2 Risk assessment and mitigation processes			
2.2.1 Risk assessment			
2.2.1.1 There is a structured process for the assessment of risk associated with identified hazards expressed in terms of severity and probability of occurrence.			
2.2.1.2 Risk assessment procedures cover all facilities, routine-nonroutine activities, and personnel having access to the workplace (including visitors, subcontractors, etc.).			
2.2.1.3 Criteria are established for evaluating risk and the level of risk the organization is willing to accept.			
2.2.1.4 The results of the risk assessment are taken into account in the development of facilities, equipment, procedures, training, etc.			
2.2.1.5 Results of hazard identification and risk assessments are considered while setting SMS objectives. (see 1.1.2)			
2.2.2 Operating procedures			
2.2.2.1 Operations and activities associated with identified risks, where control measures need to be applied, are identified.			
2.2.2.2 Operating procedure requirements cover all activities and facilities, especially activities where their absence could lead to deviations from the policy, safety objectives, and/or regulatory requirements.			

(continued on next page)

Table 33. (Continued).

2. SAFETY RISK MANAGEMENT			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
2.2.2.3 The SMS specifically addresses the coordination of SMS interfaces with external organizations including service providers, suppliers, subcontractors, etc.			
2.2.2.4 Operating criteria are stipulated in the procedures.			
2.2.3 Mitigation controls			
2.2.3.1 Corrective and preventive actions are generated in response to risk assessment or event analysis.			
2.2.3.2 The organization evaluates the effectiveness of the corrective/preventive measures that have been developed.			
2.3 Internal safety investigations			
2.3.1 There is a process to ensure that all reported occurrences and deficiencies are investigated.			
2.3.2 Investigations are targeted toward identification of the root cause and they consider human and organizational factors in the analysis.			
2.3.3 There is a process to identify lessons learned from safety-significant events that occur at other organizations.			

(continued)

Table 34. SMS assessment table for safety assurance.

3. SAFETY ASSURANCE			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
3.1 Safety performance monitoring and measurement			
3.1.1 Performance monitoring and measurement			
3.1.1.1 There are safety performance indicators and safety performance targets directly related to safety objectives.			
3.1.1.2 There is a process for reviewing the adequacy/appropriateness of safety performance indicators.			
3.1.1.3 Procedures to monitor and measure SMS performance on a regular basis are established.			
3.1.1.4 There is a process and/or procedures to ensure calibration and maintenance of monitoring equipment.			
3.1.2 Audit			
3.1.2.1 The organization conducts reviews and audits of its processes, its procedures, analyses, inspections, and training.			
3.1.2.2 There is an operationally independent audit function with the authority required to carry out an effective internal evaluation program.			
3.1.2.3 Audits address all functions, activities, and groups within the organization.			

(continued on next page)

Table 34. (Continued).

3. SAFETY ASSURANCE			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
3.1.2.4 There are defined audit scope, criteria, frequency, and methods.			
3.1.2.5 Audits take into account identified risks and previous audit results.			
3.1.2.6 Audits are carried out based on an approved and recognized SMS set of requirements.			
3.1.2.7 SMS evaluators/auditors are trained and qualified.			
3.1.2.8 Audit results are addressed.			
3.2 The management of change			
3.2.1 There is a process in place for analyzing risk resulting from changes made to operations or to key personnel.			
3.2.2 Proposed corrective and preventive actions are reviewed through risk assessment.			
3.2.3 There is a procedure to record verification of action(s) taken and the reporting of verification results.			
3.3 Continuous improvement of the safety system			
3.3.1 Continuous improvement is an inherent part of the safety objectives at all levels of the organization.			

(continued)

Table 34. (Continued).

3. SAFETY ASSURANCE			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
3.3.2 Regular and periodic planned reviews are conducted regarding organization safety processes and performance, with the objective of identifying opportunities for improvement.			
3.3.3 Major decisions and actions aimed at improving safety are monitored for their effectiveness and further action is taken when the expected risk benefit is not met.			
3.3.4 Managers are kept informed of the internal safety reviews, as well as planned and implemented risk control actions.			
3.3.5 There is an annual management review of the entire SMS.			
3.3.6 The results of the management review are documented.			

Table 35. SMS assessment table for safety promotion.

4. SAFETY PROMOTION			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
4.1 Training and education			
4.1.1 Training requirements are defined so that personnel are competent to perform their duties.			
4.1.2 Appropriate training is provided. This includes specialized training to personnel involved in safety-critical tasks, general SMS training for all personnel, and SMS training for new employees as part of the indoctrination training.			
4.1.3 Training effectiveness is measured.			
4.1.4 There is emergency preparedness and response training for affected personnel.			
4.1.5 Training records are maintained.			
4.2 Safety communication			
4.2.1 The free exchange of safety information, across all areas and through all levels, both vertically and horizontally, is actively promoted by management and facilitated by mechanisms and processes.			
4.2.2 Employees are involved/consulted in the development and review of policies and procedures to manage risks.			

(continued)

Table 35. (Continued).

4. SAFETY PROMOTION			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
4.2.3 There are multi-disciplinary, multi-level safety committees or operational committees for which safety is a standing agenda item, and where SMS-related issues are critically assessed and objectively discussed.			
4.2.4 The results of safety coordination meetings are communicated to all employees.			
4.2.5 Safety information is disseminated throughout the organization and the effectiveness of this process is monitored.			

Table 36. SMS assessment table for the emergency plan.

5. EMERGENCY PLAN			SERVICE PROVIDER
Expectations **(Specific expectation and best practice)**	**Organization reference**	**Score (meets or below)**	**REMARKS** **(Justification for score)**
5.1 Coordination of the emergency response plan			
5.1.1 Potential emergency situations and incidents are identified.			
5.1.2 The organization has emergency response procedures appropriate to the size and scope of its operations and has identified potential emergency situations and incidents (see 5.1.1).			
5.1.3 The emergency response procedures are documented, implemented, and assigned to a responsible manager.			
5.1.4 The organization has a process to coordinate emergency planning, distribute the emergency response plan and procedures, and communicate the content to all personnel.			
5.1.5 Emergency response teams are properly trained (see 4.1).			
5.1.6 The organization conducts drills and exercises (where practicable) with all key personnel at specified intervals.			
5.1.7 The emergency response procedures are periodically reviewed as part of the management review of the SMS. They are also reviewed after key changes, including organizational and personnel changes.			

ANNEX B

Using Assessment Tables

These assessment tables are designed to organize and consolidate the information and observations collected during an SMS assessment. These tables can be detached from the guidebook and used during the assessment. The tables are based on OHSAS 18002 and the Canadian CSA Standard Z, and were adapted using ICAO Doc 9859 (2006) guidelines and reviewed to address FAA AC 150/5200-37 (2007).

B.1 How to Use

The worksheets are a series of tables which contain all of the expectations associated with each SMS pillar and element. There is space for the assessment team to record information references, score, and observations (justification for the given score). The tables shown in Annex A (Tables 32 through 36) are organized as follows:

- The first column contains SMS expectations;
- The second column is for references, i.e., the source of observations or information collected during the document review or interviews;
- The third column is for the score (from 0 through 5) assigned to each expectation; and
- The fourth column is for the observations/information collected by the assessment team that justify the assigned score.

References

During the assessment, team members should collect as much information as possible to reference their observations, including the name, position, department of the person being interviewed, the observation location and time, the document title, and publication date and reference number.

If the expectations worksheets are going to be part of the final deliverable to the client, a complete reference may not appear in the final version to protect the privacy of individuals. However, this information should be available to the assessment team during the scoring process and for future reference, if required.

Scoring

Scoring should be conducted by all members of the assessment team according to the methodology outlined in Section 6.6. Pillar and element scoring should be done after all the team members' observations have been recorded on the worksheet (Annex C, Table 37).

Observations

Members of the assessment team should transfer their observations from their notebooks to the worksheets and score each expectation. There need only be one working copy of this

document, which is passed among team members. This may be done at the end of each day of the site visit.

B.2 SMS Scoring Methodology

Once all of the observations have been recorded, the team should score the SMS elements as a group. There should be a consensus, by the team, on the score assigned to each element. In the event that there is a disagreement, the Team Leader will make the final decision. The following is the criteria that should be used.

Step 1—Score Expectations

- Expectations are scored first.
- They are given a score of "MEETS Expectation" or "BELOW Expectation" based on the information collected during assessment. This is done to remove subjectivity. The score may have one or more comments associated with it that provide justification and context.
- Expectations may be scored by individual team members. Another team member may override the initial score if he/she can provide the information required to justify a change.
- Team members should come to a consensus on the score assigned to each expectation.

Step 2—Score Elements

- Sub-elements and elements are scored next.
- The assigned score is not based on a mathematical average of the expectations scores; however, expectations scores serve as a guide for pillar and element scoring.
- Sub-elements and elements are given a score of 0 through 3 as follows:
  - "**0**" is given when none of the expectations under the element are met (comments/justification required)
  - "**1**" is given when some of the expectations under the element are met (comments/justification required)
  - "**2**" is given when all expectations under the element are met (no comment required)
  - "**3**" is given when all the expectations are met or exceeded (comments/justification required)
  - "**3+**" may be assigned if the assessment team believes that the organization has done an exceptional job, meeting or exceeding all the expectations under this element, and deserves extra mention (comments/justification required)
  - "**4**" is given in the event that the organization exhibits best practice for this element (rare, extremely subjective, and may only be assigned by an SMS expert with particular industry experience [comments/justification required]).
- Add the sub-element scores to assign element scores, as required. Again, the score is not based on a mathematical average; the sub-element scores serve as a guide for the element scores.
- Elements can only be assigned whole numbers—no decimals, please!
- All team members should agree on the element scores before assigning pillar scores.
- Element scores should be recorded on the scoring table presented in Annex C.

Step 3—Add to Score Pillars

- Pillars are scored last, following a similar process to element scoring.
- The assigned score is not based on a mathematical average of the element scores. Element scoring serves as a guide for pillar scoring.
- Pillars are given a score of 0 through 4, following the same criteria used for the sub-element scores.
- Pillars can only be assigned whole numbers.
- All team members should agree on the final pillar scores.
- Pillar scores should be recorded on the scoring table presented in Annex C.

ANNEX C

Scoring Table for SMS Assessment

Table 37. SMS scoring table.

SMS pillars and elements	Sub-element score	Element score	Pillar score
1. Safety policy and objectives			
1.1. Management commitment and responsibility			
1.1.1. Policy			
1.1.2. Objectives			
1.2. Safety accountabilities of managers			
1.3. Appointment of key safety personnel			
1.4. SMS implementation and management			
1.5. Documentation			
1.5.1. Legal and other requirements			
1.5.2. SMS Documentation			
1.5.3. Documentation and data control			
1.5.4. Record and records management			
1.5.5. Coordination of the emergency response plan			
2. Safety risk management			
2.1. Hazard identification			
2.1.1. Hazard identification process			
2.1.2. Reporting systems			
2.2. Risk assessment and mitigation processes			
2.2.1. Risk assessment			
2.2.2. Operating procedures			
2.2.3. Mitigation control plans			
2.3. Internal safety investigations			

(continued on next page)

Table 37. (Continued).

SMS pillars and elements	Sub-element score	Element score	Pillar score
3. Safety assurance			
3.1. Safety performance monitoring and measurement			
3.1.1. Performance monitoring and measurement			
3.1.2. Audit			
3.2. The management of change			
3.3. Continuous improvement of the safety system			
4. Safety promotion			
4.1. Training and education			
4.2. Safety communication			

ANNEX D

List of Applicable Regulations for Certificated Airports

- Statutory Materials—United States Code, Title 49:
- Chapters 401 (General Provisions), 417 (Operations of Carriers), 449 (Security), 461 (Investigations and Proceedings), 471 (Airport Development), 475 (Noise).
- Regulations—Code of Federal Regulations (C.F.R.), Title 14 and Title 49 Aviation Laws:
- 14 C.F.R. Part 139 (Certification of airports);
- 14 C.F.R. Part 1 (Definitions and abbreviations);
- 14 C.F.R. Part 13 (Investigative and enforcement procedures);
- 14 C.F.R. Part 16 (Rules of practice for federally assisted airport enforcement proceedings);
- 14 C.F.R. Part 21 (Certification procedures for products and parts);
- 14 C.F.R. Part 36 (Noise standards: Aircraft type and airworthiness certification);
- 14 C.F.R. Part 71 (Designation of class A, B, C, D, and E airspace areas: air traffic service routes; and reporting points);
- 14 C.F.R. Part 77 (Objects affecting navigable airspace);
- 14 C.F.R. Part 91 (General operating and flight rules);
- 14 C.F.R. Part 150 (Airport noise compatibility planning);
- 14 C.F.R. Part 157 (Notice of construction, alteration, activation, and deactivation of airports);
- 14 C.F.R. Part 161 (Notice and approval of airport noise and access restrictions);
- 14 C.F.R. Part 300 (Rules of conduct in DOT proceedings under this chapter);
- 14 C.F.R. Part 302 (Rules of practice in proceedings);
- 49 C.F.R. Part 18 (Uniform Administrative Requirements for Grants and Cooperative Agreement to State and Local Governments);
- 49 C.F.R. Part 1520 (Protection of sensitive security information);
- 49 C.F.R. Part 1540 (Civil aviation security: general rules);
- 49 C.F.R. Part 1542 (Airport security);
- FAA Regulations and Policies;
- FAA Orders and Notices;
- FAA Advisory Circulars;
- FAA Policy and Guidance;
- FAA Environmental Records of Decision;
- FAA Airport Noise and Land Use Information;
- State-specific airport regulations and statutes.
- Other FAA documents:
- Certalerts;
- Engineering Briefs (EBs);
- Signs and Marking Supplement (SAMS).
- TSA Security Directives.

ANNEX E

Hazard Identification Tools

Table 38 provides summary descriptions of a selection of hazard identification and hazard analysis tools. This information was obtained from the FAA Safety Management System Manual (2004)[13], which also provides more detailed information about the tools' utility and use.

Table 38. Hazard analysis tools.

Tool or Method	Summary Description
Functional Hazard Analysis (FHA)	Uses Functional Analysis to determine "what" a system (e.g., equipment procedures or operations) must do to complete a mission or higher function. The failure or anomalous behavior of these functions is identified as a hazard and ranked according to severity based on its operational effect.
Fault/Failure Hazard Analysis	Tool to identify and evaluate component hazard modes, determine causes of these hazards, and determine resultant effects to the subsystem and its operation.
Failure Modes and Effects Analysis (FMEA) and Failure Modes, Effects, and Criticality Analysis (FMECA)	Hypothesizes failure events, which impact the operation or system. These events are identified as hazards. Often used as an input to a sub-system hazard analysis.
Operations Analysis	This provides an itemized sequence of events or flow diagrams depicting the major events of an operation or system. Failure or anomalous behavior in these events is identified as a hazard.
Preliminary Hazard Analysis (PHA)	The PHA provides an initial overview of the hazards present in the overall flow of the operation. It provides a hazard assessment that is broad, but not usually deep.
"What if..." Tool	The "what if..." tool is a brainstorming method. It is designed to add discipline and structure to the experiential and intuitive expertise of operational personnel.
Scenario Process Tool	This tool diagrams events in their logical relationships. These events or their anomalous behavior are identified as hazards.
Change Analysis	Identifies planned and potential unplanned changes to a system (e.g., operation, equipment, or procedure). Hazards are then identified using one of the other tools.
Cause and Effect Tool	Also known as the "fish bone" and Ishikawa Diagram. This is a variation of the Logic Diagram. Effects are depicted as horizontal lines with causes entering the effect line diagonally (like a fish bone). The result is the hazard.
Hazard and Operability (HAZOP) Tool	Highly structured hazard identification tool. It uses a standard set of guide terms that are then linked to a tailored set of process terms. Each link is evaluated for its validity. Valid links are identified as hazards.
Mapping Tool	Also known as Map Analysis and Zonal Safety Analysis. Uses models and schematics to identify and evaluate hazards and hazard causes. Depicts energies and sources of hazards relative to vulnerable entities.
Interface Analysis	Used to discover the hazardous linkages between interfacing systems.
Accident and Incident Analysis	Uses data on recorded hazardous events. These events are grouped in various ways according to a pre-established criteria usually a common cause or outcome. The groupings are identified as hazards.

(continued on next page)

Table 38. (Continued).

Tool or Method	Summary Description
Interview Tool	Knowledgeable operational personnel are queried or interviewed confidentially. They are asked to freely describe things that have gone or could go wrong in a system.
Inspection Tool	Also called the Survey Tool. Hazards are identified by direct observation of a system.
Job Hazard Analysis (JHA)	Used to examine the safety of a single job in detail. The job is broken down into individual stages. Each stage is then analyzed for events associated with that stage that can go wrong. These events are identified as hazards.
Opportunity Assessment	Identifies opportunities for expansion of an organization's capabilities. Risk-related barriers to this expansion are identified as hazards. The hazards are then risk managed.
Energy Trace-Barrier Analysis (ETBA)	Highly structured. Documents all energy sources in system. The energy sources are identified as hazards. Barrier between the energy sources and the operators, maintainers, and other systems are identified as mitigations.
Fault Tree Analysis (FTA)	Similar to a negative Logic Diagram but with the addition of terms (and, or, and/or, exclusion) that aid in the assessment of probability.
Multi-Linear Event Sequencing (MES)	Tool Also called the timeline tool and the sequential time event plot (STEP). Used to detect hazards from the time relationship between various operational or systemic events.
Management Oversight and Risk Tree (MORT)	Very structured and time consuming. Very detailed logic diagram useful for assessing the highest risks and most operational critical activities.
FAA Operational Support Test and Evaluation (T&E) Gold Standard for National Airspace Systems Hardware and Software Modifications	Multi-step process used by all FAA secondary maintenance organizations to design, develop, test and evaluate, and deliver hardware and software modifications to existing operational NAS systems. This process ensures that existing functionality is maintained and that modifications add new capability or improve existing capability. All safety significant functionality is verified with each delivered product baseline.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation