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Option: **Flight Operations**

THEME

Process for evaluating the implementation of SMS in the company's activities (OPS AER)

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Abstract

The implementation of a Safety Management System (SMS) is essential for safe air operations. In Algeria, particularly in the air operations domain (OPS AER), a robust evaluation process is crucial due to unique operational challenges. This thesis examines the evaluation of SMS implementation, focusing on safety reporting, databases, and performance monitoring. The research proposes a risk-based assessment process, integrating technologies like artificial intelligence (AI) to enhance accuracy and effectiveness. By assessing current SMS practices, this study identifies gaps and offers solutions for improving safety management, risk mitigation, and compliance with regulatory standards.

Keywords: Safety Management System, air operations, risk-based assessment, artificial intelligence, aviation safety.

Résumé

La mise en œuvre d'un système de gestion de la sécurité (SMS) est essentielle pour la sécurité des opérations aériennes. En Algérie, particulier dans le domaine des opérations aériennes (OPS AER), un processus d'évaluation solide est crucial en raison des défis opérationnels uniques. Cette thèse examine l'évaluation de la mise en œuvre du SMS, en se concentrant sur les rapports de sécurité, les bases de données et le suivi des performances.

La recherche propose un processus d'évaluation basé sur le risque, intégrant des technologies telles que l'intelligence artificielle (IA) pour améliorer la précision et l'efficacité. En évaluant les pratiques actuelles en matière de SMS, cette étude identifie les lacunes et propose des solutions pour améliorer la gestion de la sécurité, l'atténuation des risques et la conformité aux normes réglementaires.

Mots clés : Système de gestion de la sécurité, opérations aériennes, évaluation basée sur les risques, intelligence artificielle, sécurité aérienne.

الملخص

يعد تنفيذ نظام إدارة السلامة أمرًا ضروريًا للعمليات الجوية الآمنة. في الجزائر، لا سيما في مجال العمليات الجوية، تعتبر عملية التقييم القوية أمرًا بالغ الأهمية بسبب التحديات التشغيلية الفريدة من نوعها. تبحث هذه الأطروحة في تقييم تنفيذ نظام إدارة السلامة مع التركيز على تقارير السلامة وقواعد البيانات ومراقبة الأداء .

يقترح البحث عملية تقييم قائمة على المخاطر، ودمج تقنيات مثل الذكاء الاصطناعي (AI) لتعزيز الدقة والفعالية. ومن خلال تقييم الممارسات الحالية في مجال نظم إدارة السلامة، تحدد هذه الدراسة الثغرات وتقدم حلولاً لتحسين إدارة السلامة وتخفيف المخاطر والامتثال للمعايير التنظيمية.

الكلمات الرئيسية: نظام إدارة السلامة، والعمليات الجوية، والتقييم القائم على المخاطر، والذكاء الاصطناعي، وسلامة الطيران.

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DEDICATION

DEDICATION

I would like to express my deepest gratitude to my dear parents, who have been my greatest support throughout my educational journey, after God Almighty. I also extend my heartfelt appreciation to my siblings, Lina and Fadlallah, for their constant presence in my life.

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AI	*Artificial Intelligence*
AR	Augmented Reality
CEO	Chief Executive Officer
CFSO	The Chief Flight Safety Officer
CVRs	Cockpit Voice Recorders
DACM	the Directorate of Civil Aviation and Meteorology
DMS	Digital Document Management System
DOA	Air Operations Department
EASA	European Union Aviation Safety Agency.
FAA	Federal Aviation Administration
FH	*Flying Hours*
FSB	Flight Safety Bureau
ICAO	International Civil Aviation Organization
key performance indicators	*Key Performance Indicators*
MOR	Mandatory Occurrence Report
OCR	Optical Character Recognition
OPS AER	Air Operations
OSHE	The Occupational Safety Health and Environment
PSOE	Present, Suitable, Operating, and Effective
S/D PNT	Senior/Deputy Technical Flight Crew Member (Person Navigant Technique)
SA	Safety Analysis
SAG	SAFETY ACTION GROUPS
SD	*Standard Deviation*
SDCPS	safety data collection and processing systems
SIP TF	Safety Information Protection Task Force
SM ICG	Safety Management International Collaboration Group
SMS	Safety Management Systems
SOPs	or standard operating procedures

SPIs	Safety Performance Indicators
SRB	THE SAFETY REVIEW BOARD
SRM	THE SENIOR RESPONSIBLE MANAGER
SSP	State Safety Program
VR	*Virtual Reality*

GENERAL INTRODUCTION

GENERAL INTRODUCTION

Aviation safety has evolved significantly over the decades, driven by advancements in technology, regulatory frameworks, and operational procedures. Yet, despite these improvements, challenges remain, particularly in the implementation and effectiveness of Safety Management Systems (SMS) within the domain of air operations. The introduction of the SMS as a regulatory requirement has brought about structured methods to enhance safety, ensure compliance, and reduce operational risks.

The air operations domain, especially in regions with complex and dynamic operational environments, like Algeria, necessitates the careful application of these systems. Air operations in remote or challenging regions often face unique risks, ranging from environmental factors to the complexity of maintaining regulatory compliance. The implementation of SMS is intended to mitigate these risks by introducing systematic approaches for identifying, analyzing, and controlling safety hazards.

However, while the principles of SMS are clear, the evaluation of the system's effectiveness in specific operational contexts remains a challenge. This evaluation becomes critical for ensuring that all safety-related processes, reporting systems, and risk management procedures are functioning optimally. In the domain of air operations (OPS AER), an efficient SMS implementation must not only meet regulatory requirements but also continuously improve by leveraging new technologies and methodologies.

This thesis aims to evaluate the implementation of SMS within air operations in Algeria. By analyzing the safety reporting systems, databases, and safety indicators, this research will provide a comprehensive assessment of the current state of SMS in this specific domain. Moreover, it proposes a novel, risk-based assessment process that integrates advanced technological tools, including artificial intelligence (AI), to enhance the precision and responsiveness of SMS evaluations.

The primary objective of this research is to evaluate the level of implementation of SMS components and elements within air operations. It will also demonstrate how modern technological

tools can be incorporated into the safety management process, thus ensuring better compliance, risk identification, and mitigation.

In doing so, this thesis seeks to address the following key objectives:

- Assess the current state of SMS implementation in air operations in Algeria.

- Propose enhancements to the evaluation process by integrating technology and AI.

- Provide recommendations for improving the safety management process, focusing on risk-based

assessment methods.

CHAPTER I

REGULATORY ASPECTS OF SAFETY MANAGEMENT SYSTEM IMPLENTATION RE-QUIREMENTS

CHAPTER I : REGULATORY ASPECTS OF SAFETY MANAGEMENT SYSTEM IMPLENTATION REQUIREMENTS

I.1: Introduction:

The safety of passengers, crew members, and personnel is the top priority in the aviation industry. Airlines and aviation service providers achieve this goal by applying a systematic, proactive approach called Safety Management Systems (SMS). SMS is not only a progressive but also a structured framework that addresses the identification and risk management of all possible perils in all areas of an organization's operations. It is an accepted and required method of safety management within the aviation industry. Global regulators including the International Civil Aviation Organization (ICAO) and Federal Aviation Administration (FAA) mandate the implementation of SMS. An effective SMS includes Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion components. Together, these elements synergize to develop a safety culture and continually improve safety performance. In this segment, we will look at the fundamentals of SMS, its regulatory oversight in aviation, and the positive impacts on organizations that adopt it. Understanding the Whys and What's of SMS can pave a way for effective implementation of the system among airlines and aviation service providers around the world.

I.2: THE EVOLUTION OF SAFETY:

The history of the progress in aviation safety can be divided into three eras

a) The Technical Era (1900s-1960s): During this time, aviation transitioned into a mainstream mode of transport, and safety concerns mainly revolved around technological issues and failures. As such, safety efforts centered on the investigation and improvement of technical factors. However, with technological advancements, the frequency of accidents started to decrease from the 1950s, leading to a broader scope of safety measures that included regulatory compliance and oversight.

b) The Human Factors Era (1970s-1990s): Aviation safety made significant strides in the early 1970s due to technological innovations and tighter safety regulations, reducing the frequency of accidents. Attention shifted towards human factors issues such as the relationship between humans and machines. This spurred a search for safety information beyond traditional accident investigation. Despite efforts to mitigate human errors, it was found that they were often a recurring factor in accidents.

c) The Organizational Era (mid-1990s-present): Safety was increasingly viewed as a systemic issue, involving not just human and technical factors, but also organizational aspects. The concept of the "organizational accident" came into play, underscoring the crucial role of organizational culture and policies in the effectiveness of safety risk controls. Traditional data collection and analysis were augmented with a proactive approach, involving routine data collection and analysis to monitor known safety risks and detect potential threats. [1]

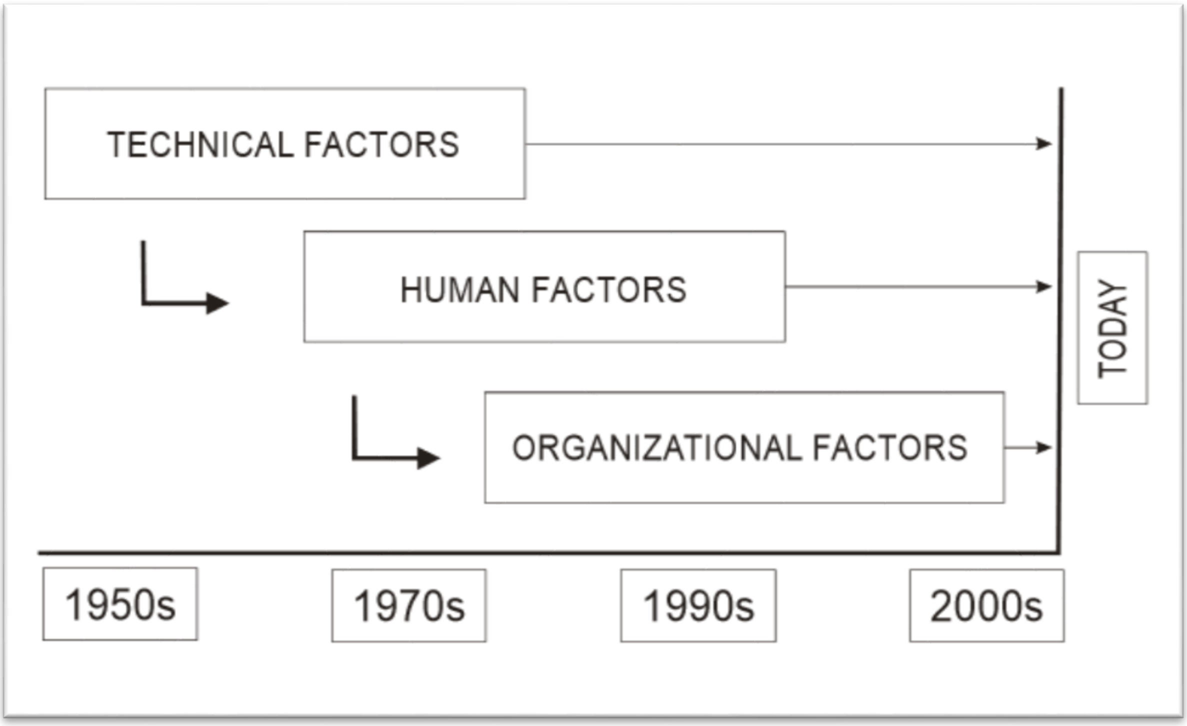


Figure I-1: LES COSSE ELECTRIQUE [1]

I.3: ACCIDENT CAUSATION:

The "Swiss-Cheese" Model, created by Professor James Reason, demonstrates that accidents result from multiple layers of system defenses being breached. These breaches can be caused by various enabling factors, such as equipment malfunctions or operational mistakes. The model asserts that complex systems like aviation have numerous defense layers, making single-point failures rarely consequential. Breaches in safety defenses can stem from high-level decisions within the system, which may remain dormant until specific operational circumstances trigger their damaging potential. Under these specific circumstances, human errors or active failures at the operational level can compromise the system's inherent safety defenses. The Reason Model suggests that all accidents involve a mix of both active and latent conditions. [1]

Active Failures:

Active failures are immediate adverse actions or inactions, including errors and violations. With hindsight, these are often seen as unsafe acts. Typically associated with front-line personnel (such as pilots, air traffic controllers, and aircraft mechanics), active failures can result in harmful outcomes.

Latent Conditions:

Latent conditions exist in the aviation system long before a damaging outcome occurs. Initially perceived as non-harmful, these conditions can remain dormant until the system's defenses are breached. Created by individuals far removed from the event in time and space, latent conditions include poor safety culture, subpar equipment or procedural design, conflicting organizational goals, defective organizational systems, or flawed management decisions. The organizational accident perspective focuses on identifying and mitigating these latent conditions on a system-wide scale, rather than solely addressing active failures by individuals. [1]

Figure 2 demonstrates how the Swiss-Cheese Model helps explain the interplay between organizational and managerial factors in causing accidents. The model shows that multiple defenses are integrated into the aviation system to guard against variations in human performance and decisions at all system levels. While these defenses aim to protect against safety risks, breaches that penetrate all defensive layers can potentially lead to catastrophic outcomes. Moreover, Reason's Model highlights that latent conditions always exist within the system before an accident and can surface through specific local triggering factors. [1]

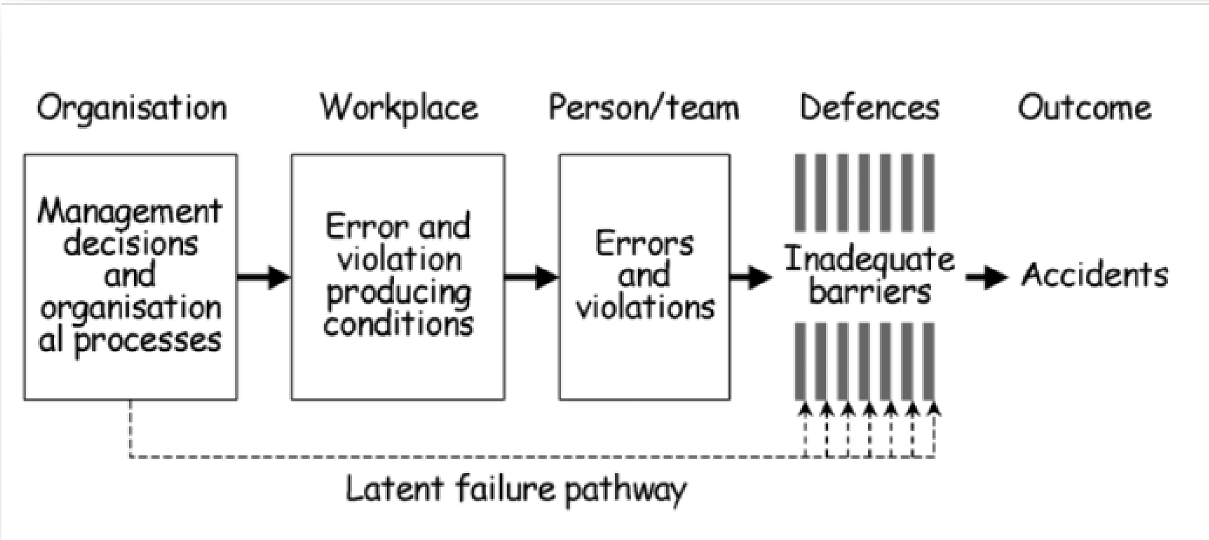


Figure I-2:The concept of accident causation

I.4: The organizational accident:

The organizational accident, according to Reason's Model, is a complex safety hazard that arises from multiple interconnected failures within an organization's processes and defenses. These failures include latent conditions (hidden safety risks in the system) and active failures (errors or intentional deviations by personnel). Reason's Model explains the organizational accident through a five-block system, where organizational processes at the top can create latent conditions or normalize deviance. Deficiencies in resource allocation or communication may result in the normalization of deviance (exceptions becoming the norm), leading to rule violations**.**

Safety defenses, including technology, training, and regulations, act as the last line of defense against latent conditions and human performance lapses. However, workplace conditions such as workforce stability, qualifications, and management credibility directly affect the efficiency of personnel and can exacerbate active failures.

By focusing safety efforts on both organizational processes (to identify and mitigate latent conditions) and workplace conditions (to minimize active failures), organizations can address the underlying systemic issues that lead to safety breakdowns. This approach creates a culture of safety and promotes proactive risk management, ultimately enhancing aviation safety performance. [1]

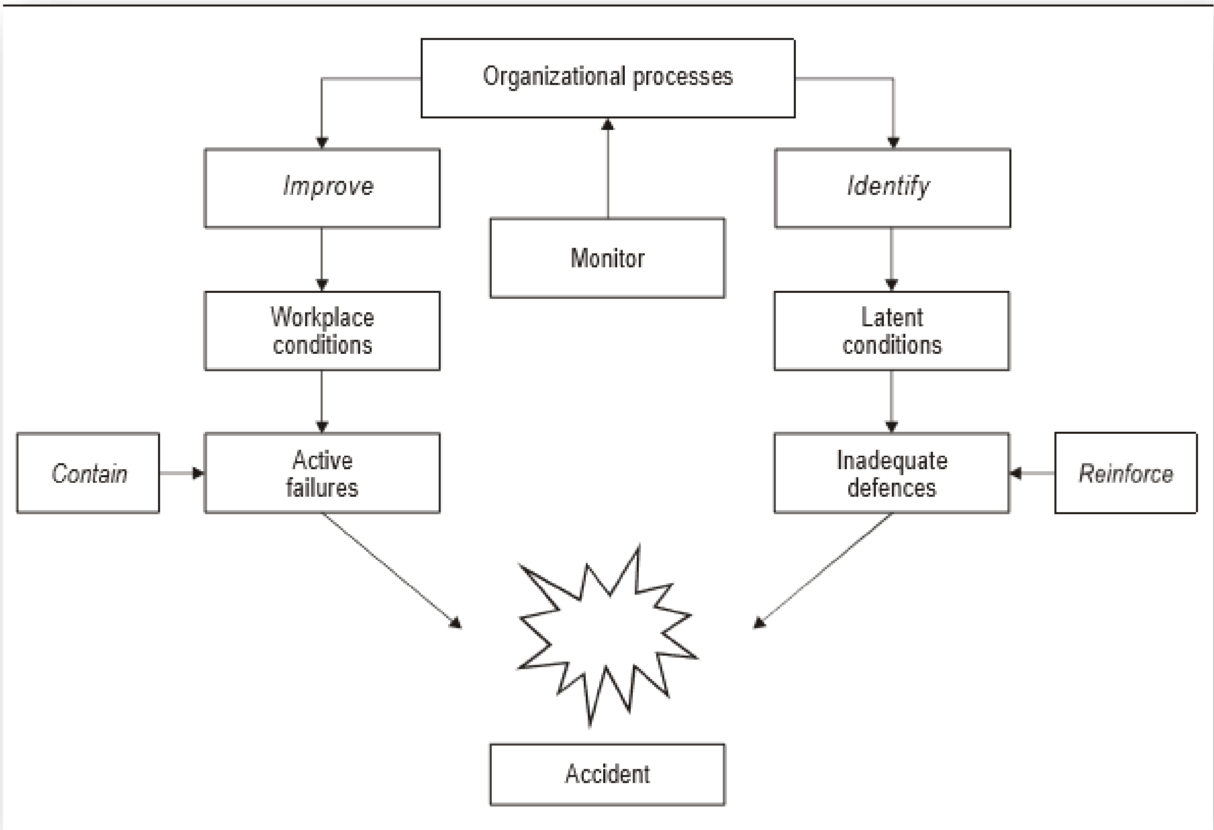


Figure I-3:The organizational accident

[1]

I.5: PEOPLE, CONTEXT AND SAFETY:

The aviation system is a complex network of product and service providers and state organizations, all of which interact to provide safe air travel. Given the interconnected nature of this system, it's important to consider the human element and how human performance may be influenced by its various components. [2]

A comprehensive assessment of the human contribution to safety is crucial for understanding how factors such as training, experience, workplace conditions, and organizational processes can impact the overall safety performance of the aviation system. [1]

The SHELL Model is a conceptual tool that provides a framework for analyzing the interaction between humans and other workplace components in the aviation system. Figure 4 illustrates this relationship, showing the four components that make up the SHELL Model:

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

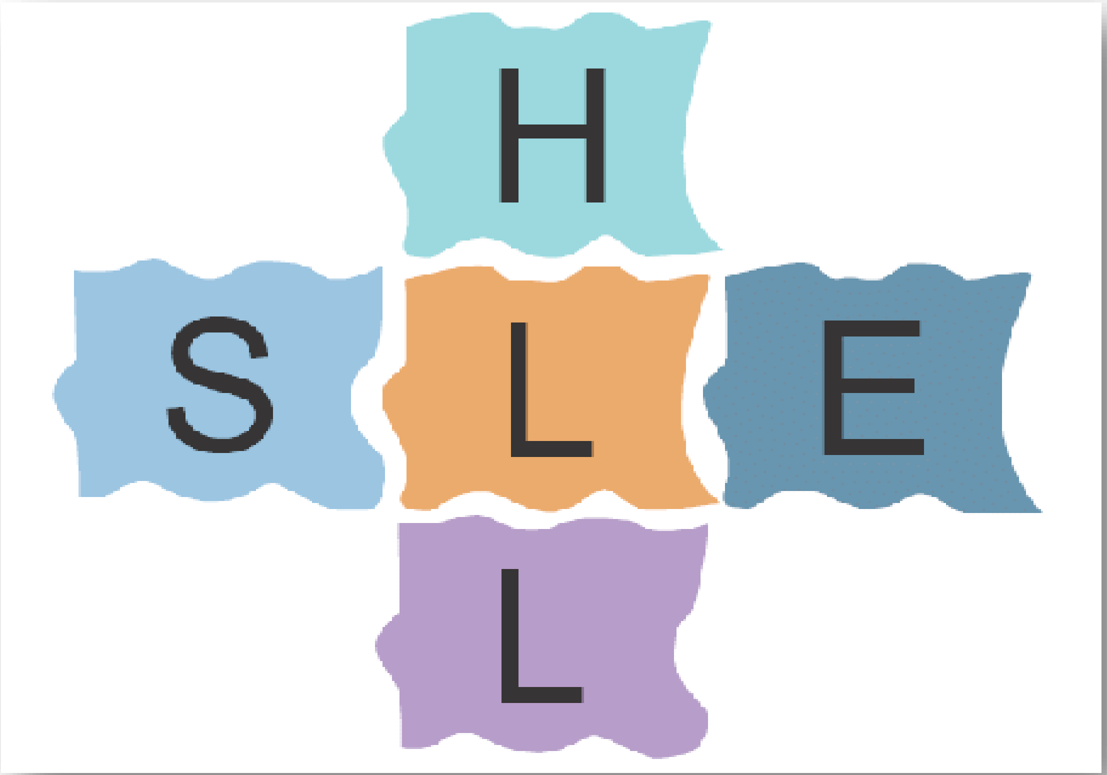


Figure I-4: The SHELL model

[1]

a) Software (S): Encompasses non-physical elements such as procedures, manuals, regulations, and computer software, focusing on how effectively these support the human operator's tasks. [3]

b) Hardware (H): Pertains to the physical elements of the system, including machinery, equipment, tools, and the overall physical environment, examining their design, layout, and functionality in relation to human performance.
c) Environment (E): Encompasses the physical, social, and organizational context in which the system operates, including factors like temperature, lighting, noise, workspace, and organizational culture that influence human performance.
d) Liveware (L): Represents the human element, including the physical and psychological characteristics of individuals within the system, addressing aspects such as human capabilities, limitations, training, experience, and fatigue.
e) Liveware-Liveware (L-L): Focuses on the interactions between individuals within the system, covering communication, teamwork, leadership, and social interactions, all critical for effective system performance.

The SHELL model underscores the importance of considering all these components and their interactions to understand and improve human performance and safety in complex systems. Widely adopted in aviation, it aids in identifying potential human factor issues and implementing solutions to enhance safety and efficiency. [1]

I.6: Understanding operational errors:

Human error is considered a contributing factor in most aviation incidents; even competent people make mistakes, often unintentionally. These errors should be accepted as a normal part of any system where humans and technology interact. Statistically, millions of operational errors are committed before a breach in safety occurs. [4]

Three strategies for controlling human error

- ❖ Error reduction strategies intervene at the source of the error by reducing or eliminating the contributing factors.
- ➢ Human-centered design
- ➢ Ergonomic factors
- ➢ Training
- ➢ …

- ❖ Capture strategies intervene when the error has been made, intercepting the error before it generates harmful consequences.
  - ➢ Checklists
  - ➢ Work sheets
  - ➢ Flight progress sheets
  - ➢ …
- ❖ Error tolerance strategies are used to increase the system's ability to accept errors without serious consequences.
  - ➢ Redundant systems
  - ➢ Structural inspections.
  - ➢ …

I.7: Safety culture:

Culture can be described, in simple terms, as ‘collective mental programming’, one of the most graphic descriptions of culture represents it as ‘mental software’ Culture influences the values, beliefs and behavior we share with other members of our various social groups Culture connects us as members of groups and provides us with cues and signals on how to behave in normal or unusual situations. Culture sets the rules of the game or the framework for all our interpersonal interactions. It is the sum total of the ways in which people go about their business in a particular social environment and it sets the context in which things happen. In terms of safety management, understanding culture is as important as understanding context, because culture is an important determinant of human performance.

Organizational performance is subject to cultural influences at every level.

Each level. The three levels of culture discussed are relevant to safety management initiatives because all three are determinants of organizational performance

- ➢ **National culture:** differentiates the national characteristics and value systems of different countries. People of different nationalities differ, for example, in their reaction to authority, the way they deal with uncertainty and ambiguity, and the way they express their individuality. They do not all have the same way of being attentive to the collective needs of the group (team or organization). In collectivist cultures, for example, unequal status and deference to leaders are accepted. This can affect the ability to question the decisions or actions of elders - an important consideration in teamwork, for example. A mix of national cultures in a mission can therefore affect team performance by creating misunderstandings. [5]

- **Professional culture:** differentiates characteristics and systems of particular professional groups (typical behavior of pilots towards air traffic controllers or maintenance engineers). Through staff selection. education and training, on-the-job experience peer pressure, etc. professionals (doctors. lawyers. pilots. controllers) tend to adopt the value system and develop patterns of behavior consistent with those of their peers They generally share pride in their profession and are motivated to excel. They are also likely to adopt value systems that lead them to develop a sense of personal invulnerability, the impression that their performance is not affected by personal problems, or that they will not make mistakes in highly stressful situations. [3]
- **Organizational culture: distinguishes** the characteristics and value systems of certain organizations (e.g., the behavior of employees in one company versus another, or the public sector versus the private sector). Organizations serve as a shell for national and professional cultures. Pilots in an airline, for example, may come from a variety of professional backgrounds. They may also come from distinct operational cultures as a result of mergers or redundancies. [1]

I.8: The management dilemma:

Safety management processes play a crucial role in identifying potential hazards that can negatively impact safety. These processes also offer reliable and unbiased methods to assess the risks associated with these hazards and implement strategies to either eliminate the hazards or reduce the risks they pose. As a result, these processes help in achieving an acceptable level of safety while ensuring a balance in resource allocation between production and protection. To describe this balance, the concept of a "safety space" is particularly helpful. The notion of a safety space highlights how the allocation of resources is optimized to maintain safety while allowing for efficient production. [1]

I.9: Safety space:

In any organization involved in service delivery or production, there is an inherent link between production levels and safety risks. As production increases, safety risks may also rise if the necessary resources or process enhancements are not implemented. Organizations must define their production and safety objectives by balancing output with acceptable safety risks. Additionally, when setting production goals, organizations need to establish defenses to manage safety risks effectively. [5]

For product or service providers, fundamental safety defenses include technology, training, and internal processes and procedures. For State organizations, similar defenses apply, including personnel training, appropriate technology use, effective oversight, and supporting internal processes and procedures. The "safety space" is the zone where an organization balances desired production with required safety protections through safety risk controls. [6]

For instance, a manufacturer or air navigation service provider may plan to support anticipated growth by investing in new technologies. These technologies can enhance efficiency, reliability, and safety performance. Decision-making in this context should assess both the added value to the organization's objectives and the associated safety risks. Over-allocating resources to protection or risk controls can make the product or service unprofitable, threatening the organization's viability. [3]

Conversely, over-allocating resources to production at the expense of protection can degrade safety performance and potentially lead to accidents. Therefore, it is crucial to define a safety boundary that provides early warnings of any developing imbalance in resource allocation. Management must set and continually review these safety space boundaries to ensure they accurately reflect the current situation). [2]

Balancing production and protection is a well-understood and accepted requirement for product and service providers. This balance is equally important for State organizations managing their State Safety

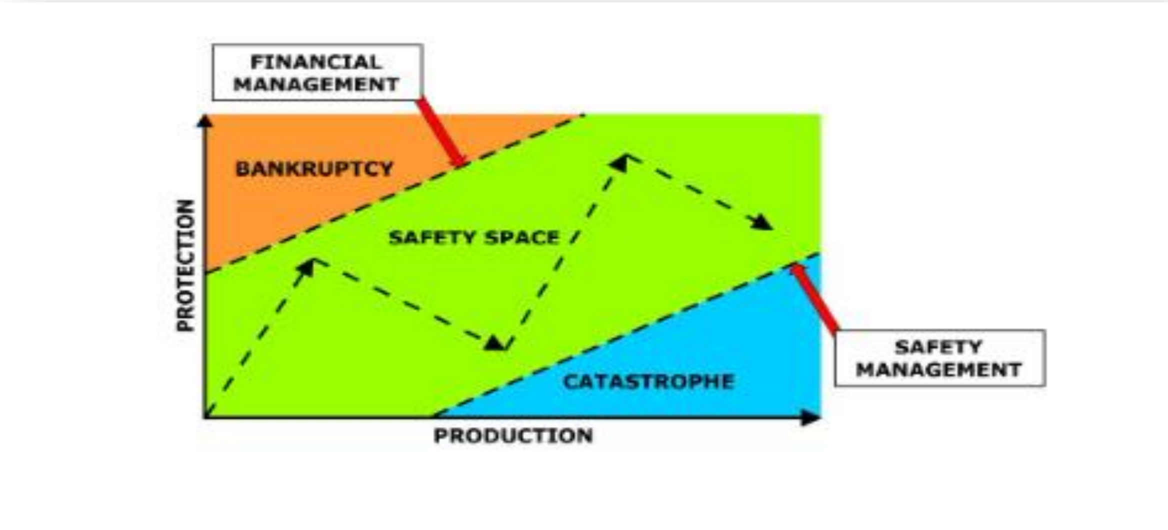


Figure I-5:The safety space [3]

Program (SSP), which requires balancing resources for State protective functions, including certification and surveillance. [1] [7]

The Safety Management System Implementation Plan:

Each air service provider must develop a Safety Management System (SMS) implementation plan, approved by the organization's senior management, which defines the organization's approach to safety management in a way that responds to the organization's safety objectives. [6]

The Safety Management System Implementation Plan defines the organization's approach to safety management. As such, it is a realistic strategy for the implementation of a Safety Management System that meets the organization's safety objectives while supporting efficient and effective service delivery. The Safety Management System Implementation Plan Specifies:

- the actions to be taken,
- Who will take them, and
- When they will be taken.

The implementation plan is developed by a planning group that:

- Includes a good base of experience;
- Holds periodic meetings with senior management;
- Is provided with resources (including time for meetings).

A typical implementation plan for a Safety Management System (SMS) includes the following components:

1. Security policy;
2. System description;
3. Gap analysis;
4. SMS components;
5. Security roles and responsibilities;
6. Safety policy and reporting system;
7. Means put in place for employee participation;
8. Safety performance measurement;
9. Safety training plan;
10. Safety communications plan;
11. Senior Management Safety Performance Oversight.

Once drafted, the senior management approves the implementation plan of the SMS. A typical implementation timeframe for an SMS is one to four years. [2] [6]

I.10: COMPONENTS AND ELEMENTS OF A SMS:

The DACM has specified in its orders the general rules relating to the implementation of safety management systems and describes the main elements required to build an SMS.

“As a minimum, the SMS of an aeronautical services certificate holder

(a) define a safety management policy and objectives:

(b) provides for the management of risk, including the identification of hazards, the avoidance, reduction and maintenance of risk to as low a level as is reasonably achievable through the implementation of appropriate actions

(c) ensure that safety is maintained, in particular by monitoring the regular assessment of safety performance and any changes which may affect it, with a view to continuous improvement;

(d) ensure the promotion of safety, in particular by defining methods and encouraging practices designed to raise and maintain risk awareness among the personnel involved". [6]

An SMS is therefore made up of four components, representing the two essential business processes that underpin it, as well as the operational arrangements needed to support these processes:

a) safety policy and objectives,

b) safety risk management

c) safety assurance

d) safety promotion.

The four components, combined with the twelve elements constitute the ICAO SMS framework, intended to provide a rational guide for the development and implementation of a service provider's SMS, as follows:

1. Safety policy and objectives
    1.1. Management commitment and responsibility
    1.1. Safety accountabilities
    1.2. Appointment of key safety personnel
    1.3. Coordination of emergency response planning
    1.4. SMS documentation

2. Safety risk management
    2.1. Hazard identification
    2.2. Safety risk assessment and mitigation

3. Safety assurance
    3.1. Safety performance monitoring and measurement
    3.2. The management of change
    3.3. Continuous improvement of the SMS

4. Safety promotion
    4.1. Training and education
    4.2. Safety communication. [1] [7] [8]

I.11: THE FOUR PHASES OF SMS IMPLEMENTATION:

A phased approach is proposed to help effectively manage the workload associated with SMS implementation. Each phase is based on the introduction of specific elements of the ICAO SMS size of the organization and the complexity of the services provided. [2]

I.11.1:Phase 1 : Planning

Planning should provide an overall plan for how the SMS requirements will be met and integrated into the organization's work activities, and a framework of accountability for SMS implementation:

- Identify the senior manager responsible for safety and the safety responsibilities of managers.
- Identify within the organization, the person(s) (or planning group) responsible for implementing the SMS.
- Develop a description of the system, which is the content of the (one or more) operator manual(s).
- Conduct a gap analysis of the organization's existing resources compared to national and international requirements for establishing an SMS.
- Develop an SMS implementation plan based on national requirements and international standards, the description of the system, and the results of the gap analysis.

- Coordinate the emergency response plan with the emergency response plans of all organizations that have a role to play during an emergency.
- Establish safety policy and objectives documentation.
- Develop and establish safety communication means.

I.11.2:Phase 2: Reactive Processes

Reactive processes should implement SMS implementation plan elements related to safety risk management based on regulatory processes.

- Implement the elements of the SMS implementation plan that relate to the safety risk management component - reactive processes.
- Provide training related to reactive processes:
- SMS implementation plan elements
- Safety risk management component
- Implement a documentation system related to reactive processes:
- SMS implementation plan elements
- Safety risk management component

I.11.3:Phase 3: Proactive and Predictive Processes

Proactive and predictive processes should implement SMS implementation plan elements related to safety risk management based on proactive and predictive processes:

- Implement the elements of the SMS implementation plan that relate to the safety risk management component - proactive and predictive processes.
- Provide training related to proactive and predictive processes.
- Implement a documentation system related to proactive and predictive processes.

I.11.4:Phase 4: Safety Assurance

Operational safety assurance should implement an operational safety assurance system:

- In collaboration with the civil aviation authority, develop safety performance indicators and safety performance objectives.

- Initiate safety performance monitoring and measurement, including change management and continuous improvement of SMS.
- Provide training related to safety assurance.
- Implement a documentation system related to safety assurance processes. [1] [7] [8]

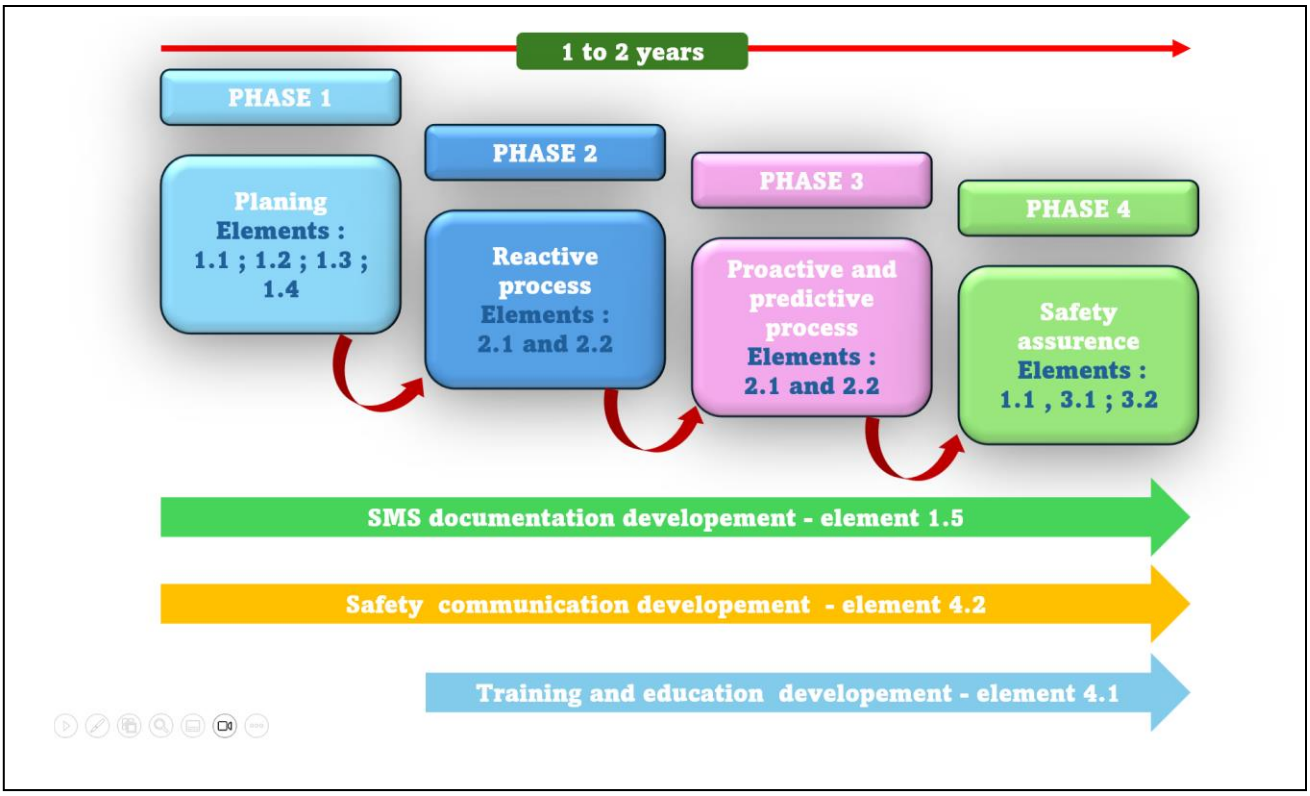


Figure I-6:Chronogram of SMS implementation phases [3]

I.12: Conclusion:

The implementation of a comprehensive and effective Safety Management System is essential for ensuring the safety of aviation operations. Regulatory requirements for SMS vary globally, but generally follow a similar approach. Effective implementation of SMS requires a dedicated planning group, clearly defined roles and responsibilities, safety policies, analysis of safety data, employee involvement, and senior management oversight. By implementing and maintaining an effective SMS, organizations can enhance safety performance, reduce risks and address safety hazards in a proactive manner. [2]

CHAPTER II

PRESENTATION OF SMS PROCEDURES USED IN AIR OPERATIONS

CHAPTER II : PRESENTATION OF SMS PROCEDURES USED IN AIR OPERATIONS

II.1: Introduction:

Aviation operations are inherently complex and hazardous, making effective safety management a critical concern for the industry. Safety Management Systems (SMS) provide a systematic approach to managing safety risks, helping aviation organizations to identify and mitigate potential hazards before they lead to accidents or incidents. [4]

In this chapter, we will delve into the various SMS procedures used in aviation operations, including hazard identification and risk assessment, incident reporting and investigation, and corrective action implementation. [4]

II.2: Safety policy and objectives:

The purpose of this section is to describe how each aviation service provider must comply with the circular establishing the General Rules for the Implementation of Safety Management Systems (SMS), which stipulates the following:

“1. As a minimum, the SMS of an aeronautical services certificate holder:

a) defines a safety management policy and objectives;”

Safety policy and objectives” is the first component of an aeronautical service provider's SMS.

provider's SMS and comprises 5 elements, including:

1.1 Management commitment and responsibility

1.2 Safety accountability

1.3 Appointment of key safety personnel

1.4 Coordination of emergency response plans

1.5 SMS documentation

The following subsections explain each element. [7]

II.2.1: Management commitment and responsibility:

The senior manager responsible for Air Algérie in his capacity as Chairman and Chief Executive Officer has ultimate control over the activities of personnel and the use of resources which are directly related to, or necessary for, the provision of services. The company's exposure to safety hazards is a consequence of its activities directly related to the provision of services. [1]

Through the specific activities of personnel and the use of resources, management can actively control safety risks in relation to the consequences of hazards. Examples of such activities include hiring, training and supervising staff, and acquiring human and material resources to support service delivery activities. It must ensure that staff comply with the company's directives, guidelines, instructions and safety procedures and that its equipment remains in good working order. A safety policy is a general plan of action defined by management to preserve the integrity of people, their associated property and the company's resources.

This policy reflects management's strategic vision for achieving the highest possible level of safety. [7] [1]

II.2.2:Safety culture:

To foster a safety culture, policies should collect and analyze all occurrences, not only those with significant effects. The occurrences sought are those that are likely to demonstrate an abnormal level of risk. [5]

To accomplish this, we must foster a positive safety culture through mobilisation, awareness-raising, and continual collaboration with our employees.

To implement an effective safety management system, senior management must demonstrate a commitment to safety, responsible staff must be aware of their impact on safety, an internal environment that encourages feedback, realistic rules and procedures must be in place, and employees should be educated on the potential consequences of unsafe acts. [6]

Line management supports and encourages these components, which are subsequently shared by functional managers.

Managers are the main forces behind this culture. The company's safety culture will be measured by what is done rather than what is said. [1]

Cultural characteristics that demonstrate the presence of a good safety culture include:

- **A flexible culture:** the ability to adapt quickly to new and dangerous situations.

- **An enlightened culture (information culture):** People are aware of the hazards and risks inherent in their business.

  Staff are always aware of the possibility of failure and constantly strive to identify and address operational hazards.

- **A Just Culture:** Mistakes must be understood, but voluntary violations must not be tolerated. The workforce knows and agrees what constitutes acceptable and unacceptable behavior.

- **A Reporting Culture:** People are encouraged to raise safety concerns. As soon as a concern is raised, it is investigated and appropriate action is taken.

- **A Training Culture:** People are encouraged to hone and apply their own skills and knowledge to enhance the company's safety. The company keeps staff informed about safety issues Safety reports are circulated on employee newsletters so that everyone can learn from them. [1] [8]

II.2.3:Safety objective:

Safety objectives can take the form of a brief statement describing in general terms The organization’s expectations in general terms so that they are in the form of specific, measurable goals against which the success of the SMS can be measured.

Safety management and the company's operational bodies identify safety objectives at the beginning of each year, which must be linked to the safety performance indicators.

It is essential, however, to define quantified targets or expected trends for each indicator from the outset, even if these are not yet known for each indicator, even if these objectives need to be adapted later on in the light of These targets may need to be adapted subsequently, taking into account experience, as reference data may come from a variety of sources (recurring SAFA deviations, incident/hazard reports, safety audits, specific studies, exchanges between organizations, etc.). [8]

Safety performance indicators are based on the following three axes:

- Indicators on the consequences of operations (long delays, return parking, QRF, QRG, diversion, etc.)
- Indicators on major risks requiring special monitoring (runway excursion, ground collision, unstable approach, hard landing, etc.)
- Indicators relating to feedback to staff (number of reports received per month/year, time taken to communicate measures taken in response to identified risks, etc.).

Depending on the specific nature of each structure, the objectives will be different and are generally defined according to the situation on the ground.

Safety objectives are quantified and expressed as a percentage or an absolute value.

Action plans are drawn up to achieve the predefined objectives.

Trend monitoring and the evaluation and measurement of safety indicators (quarterly, half-yearly and annually) are carried out by the safety advisers of each operational structure.

Meetings are organized with the safety advisers of the operational departments, the Head of Flight Safety and the Director of Safety to discuss the effectiveness of the measures (defenses) established.

During the meeting, defenses may be introduced, removed or modified as deemed necessary by those present. [1]

At the end of each year, each operational department draws up a summary of trends in

Of safety performance indicators for the previous year.

Under the Safety Management System (SMS), the aviation service provider must develop and implement a safety policy that complies with national and international regulations. The policy must be signed by the Chief Executive Officer, who will be held accountable for its implementation.

The policy should include:

- Commitment to a positive safety culture, including a non-punitive reporting environment. This ensures that staff feel comfortable reporting safety incidents and near-misses, leading to greater transparency and learning opportunities.
- Clear lines of responsibility for risk management within the aviation service provider. This ensures that all relevant staff are aware of their roles and responsibilities in identifying, assessing, and controlling risks.
- A statement committing the provision of necessary human and financial resources for the implementation of an effective SMS. This ensures that staff have the support and tools they need to implement and maintain the SMS effectively.
- Clear safety objectives and performance measurement tools for the aviation service provider. This ensures that staff are working towards defined safety goals and that progress can be monitored and evaluated.

The policy must be widely disseminated and supported visibly by all levels of management within the organization. It should be regularly reviewed to ensure that it remains relevant and appropriate for the organization. [1] [8]

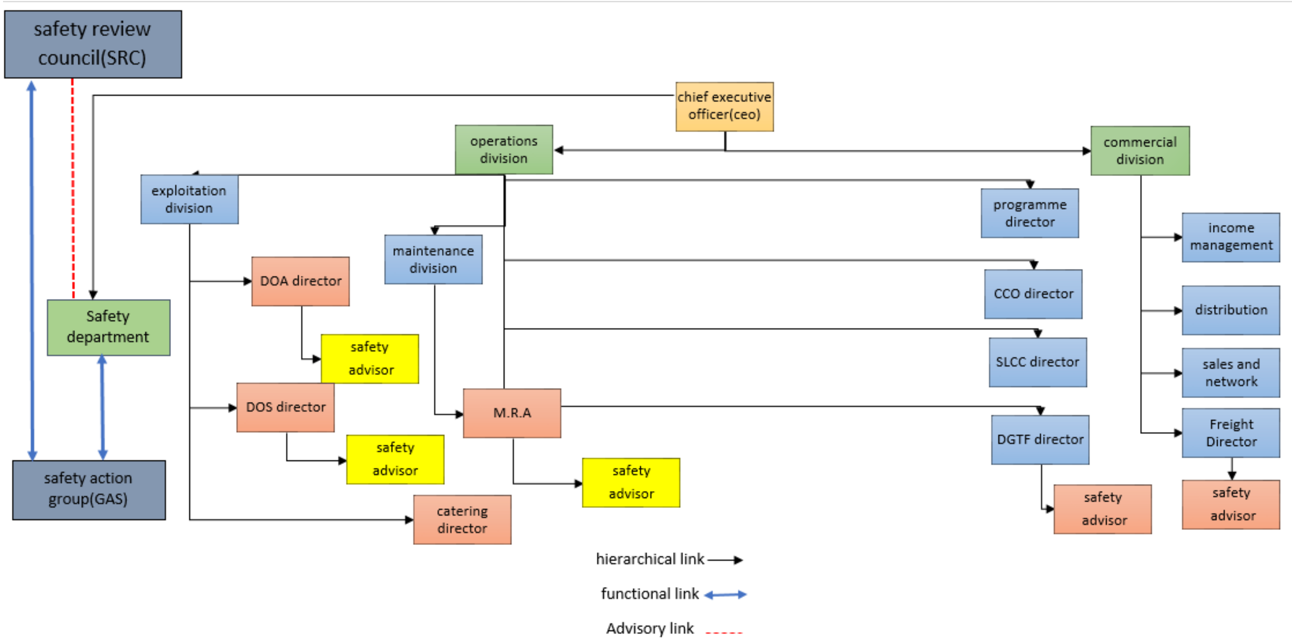


Figure II-1:Hierarchical and Functional Link in the Context of SMS Organogram

II.3: Key Safety Personnel within Air Algeria:

II.3.1:THE SENIOR RESPONSIBLE MANAGER (SRM):

Effective safety management systems depend on strong commitment from all levels of an organization, including senior management, with the goal of continually improving safety standards. Therefore, all aviation service providers are required to appoint a Chief Safety Officer. The Chief Safety Officer is responsible for setting, implementing, directing, and managing the organization's safety policy and is ultimately accountable for its safety performance. [7]

The Chief Safety Officer is a single individual with ultimate responsibility for ensuring effective and efficient operation of the safety management system. They have the authority necessary to ensure compliance with regulatory requirements and have accepted formal accountability obligations for the safety management system. [3]

The role of the Chief Safety Officer encompasses multiple responsibilities, including:

- Developing and implementing the organization's safety policy and procedures.
- Ensuring that the organization complies with national and international safety regulations.

- Providing leadership and guidance to the organization's staff on safety matters, including the reporting of safety incidents and near-misses
- Monitoring and evaluating the organization's safety performance and identifying areas for improvement
- Managing the safety management system, including the collection, analysis, and reporting of safety data
- Coordinating with other departments and stakeholders to ensure a comprehensive approach to safety management
- Advocating for the allocation of necessary human and financial resources for effective safety management. [7]

II.3.2:Director of Safety Services:

The appointment of a Director of Safety Services is mandatory for all aviation service providers. This individual reports directly to the Chief Safety Officer and is responsible for implementing the Safety Management System (SMS). In addition to reporting directly to the Chief Safety Officer, the Director of Safety Services must develop professional relationships with all areas of the organization involved in risk management. [7]

The Director of Safety Services is responsible for ensuring that operational managers establish and execute SMS procedures and processes for all critical services and facilities. [2]

Their primary role is to advise and guide operational managers to ensure that SMS is implemented consistently and homogeneously across the aviation service provider. They are also responsible for preparing the annual SMS performance report for the Chief Safety Officer.

It is important to note that for aviation service providers holding multiple aviation service certificates, the Director of Safety Services must ensure coordination with the safety managers of each unit (airports, air traffic control units, etc.) in order to ensure that all certified activities are managed under the SMS.

The Director of Safety Services is also responsible for managing the SMS databases and ensuring that the data is accurate, up-to-date, and accessible to all relevant stakeholders. They must analyze safety data to identify trends and issues, and recommend corrective actions as appropriate. [7]

Additionally, the Director of Safety Services plays a critical role in the development and implementation of safety-related training programs. They must work closely with training managers to ensure that all staff receive the necessary training to perform their duties safely and effectively.

The Director of Safety Services must also be familiar with the organization's safety performance metrics and be able to report on these metrics to senior management and relevant stakeholders. They must be able to identify areas where safety performance is sub-optimal and develop action plans to address these issues.

Another important aspect of the Director of Safety Services' role is the management of safety audits and inspections. They must work closely with auditors and inspectors to identify safety risks and develop corrective actions to mitigate these risks. [7]

II.3.3:THE SAFETY REVIEW BOARD (SRB) :

The SRB is a high-level committee within the organization, chaired by the responsible Senior Manager, made up of functional managers and may include members of the Board of Directors. The Director of Security Services participates in an advisory capacity

Only. The SRB:

- Monitors the effectiveness of the SMS implementation plan;
- Monitors that required mitigating actions are taken in a timely manner;
- Monitor safety performance against the organization’s safety policy and objectives;
- Monitor the effectiveness of the SMS processes;
- Ensures that appropriate resources are allocated to achieve safety performance beyond that required for regulatory compliance; and
- Provides strategic direction to the ASG.

II.3.4:SAFETY ACTION GROUPS (SAG):

The Safety Action Groups (SAG) report to the SSC and draw strategic guidance from it. SAGs are chaired by functional managers and involve other members from various operational sectors. The Director of Safety Services serves as the SAG's secretary. SAGs are primarily tactical and focus on operational activities related to safety risk management. They:

- supervise operational safety performance in functional areas and ensure appropriate safety risk management processes are conducted.
- coordinate the development of risk mitigation strategies and ensure safety data capture and lessons learned documentation.
- Evaluate the impact of operational changes on safety.
- Coordinate the implementation of corrective action plans and hold working meetings to ensure the involvement of all operational employees in safety management.
- Ensure that corrective actions are taken in a timely manner.
- Review previous risk mitigation strategies to ensure their effectiveness.
- Supervise and promote safety awareness and ensure that safety, emergency procedures, and technical training for employees is carried out. [7]

II.3.5:Chef of Flight Safety Bureau (FSB) :

The Chief Flight Safety Officer (CFSO) is an independent individual whose role necessitates a methodical approach, a high level of loyalty, and the capacity to act rapidly in changing and unpredictable conditions. Their connection with the General Directorate supports their duties in supervising and managing safety, as well as creating an effective safety policy throughout the organization.

The CFSO's responsibility is to apply accident prevention measures throughout the firm.

The CFSO's responsibilities include:

- Identifying and assessing hazards in order to propose measures to avoid them.
- Reporting to the responsible authority and monitoring corrective actions.
- Evaluating the results of safety initiatives.
- Promoting a culture of safety within the organization. [9]

II.3.6:Flight Safety Officers:

The Flight Safety Officers play a crucial role in maintaining a strong link between the pilots and the Flight Safety department. With their analytical expertise, they assist the Chief Flight Safety Officer in carrying out various safety-related tasks.

Their main responsibilities include:

- Validating occurrences of standard deviation during flight analysis.
- Identifying safety hazards and assessing their risks.
- Participating in internal safety investigations.
- Promoting a safety culture within the organization.
- Ensuring the proper use of the safety reporting system by crew members.
- Organizing safety awareness sessions.
- Participating in flight analysis committees and promoting the sharing of lessons learned. [9]

II.3.7:Flight Analysis Commission:

The Flight Safety Bureau (FSB) organizes the Flight Analysis Committee at least three times a year. The purpose of the Flight Analysis Committee is to periodically review hazardous events and take appropriate corrective actions, as well as share lessons learned. [1]

This committee is composed of:

- Director of Flight Operations
- Chief Flight Safety Officer
- Flight Safety Officers (FSB)
- Designated sector representatives and instructors
- Chief Pilots (S/D PNT)
- Designated sector chiefs
- Flight Training Representative (PNT)
- Quality Assurance Officer DOA
- Safety Adviser DOA.

The Flight Analysis Committee meets to review selected cases for analysis and safety trends identified by the Flight Safety in collaboration with sector representatives, depending on their severity and possible contribution to prevention.

The analysis of a case is similar to that of an incident and others for improving the prevention program.

Data provided by the crew is an essential component of the analysis, following a procedure that guarantees anonymity. An analysis of the data is sent to the captain, who transmits it to the crew.

Based on these analyses, the committee frequently makes recommendations to improve documentation, procedures, or training. [9]

II.3.8:Flight Safety Committee:

The Flight Safety Committee is tasked with providing clarity on the safe operation of all aircraft types in the company's fleet, and reporting to the CEO on the company's safety performance relative to its flight safety standards.

The committee meets at least once a year, or at the request of the Responsible Senior Manager (CEO), and is chaired by the CEO.

The committee members include:

- CEO
- Head of Operations
- Head of Operations Division
- Head of Maintenance Division
- Director of Flight Operations
- Director of Fleet Technical Management
- Director of Ground Operations
- Director of Cargo
- Director of Quality and Process Redesign

- Chief Flight Safety Bureau
- Security Director (as secretary)

In these functions, the Flight Safety Committee ensures:

- Identification and evaluation of safety deviations.
- Setting safety goals and checking if these goals are achieved.
- Monitoring the effectiveness of corrective actions.
- Inform the concerned management of insufficient safety performance.

The Flight Safety Committee, in fulfilling these responsibilities, contributes to the continuous improvement of the company's safety performance, promoting a culture of safety and proactive risk management.

By regularly reviewing and analyzing safety incidents, safety inspections, and safety performance data, the committee can identify areas for improvement and ensure that corrective actions are implemented effectively.

This process helps the company to maintain the highest standards of safety in its operations, protecting the safety of its passengers, crew, and the public. [9]

II.3.9:Safety advisors:

At the level of each operational department of Air Algérie, a Safety Advisor is designated to ensure the implementation of the Safety Management System (SMS), and its compliance with the organization's SMS. The Safety Advisor is responsible for serving as a liaison between their functional department and the Safety Department.

In this role, the Safety Advisor is responsible for managing the safety risk in their department by:

- Ensuring the safety of activities in their department.
- Promoting safety within their department.
- Providing continuous information to their director on all aspects related to the different elements of their department's Safety Management System.

- Participating with their director and the staff in the development of corrective measures.
- Coordinating with the different services of their department to facilitate the implementation of the Safety Management System.
- Informing and coordinating with the Security Director on all aspects related to the different elements of their department's Safety Management System. [9]

II.4: The SMS implementation plan for Air Operations Department:

Air Algérie has committed to implementing a Safety Management System (SMS) by September 2012, in line with regulations set by the Directorate of Civil Aviation and Meteorology (DACM). The direction of safety, as appointed by the General Management of Air Algérie, has been tasked with establishing and ensuring the effective functioning of the SMS across all organizational structures, including the Air Operations Department (DOA). [9]

II.4.1:SMS/DOA implementation action plan initiatives:

Due to the requirements set by the International Civil Aviation Organization (ICAO) and the Ministry of Transport (DACM), Air Algérie was required to implement a Safety Management System (SMS) by September 2012. The direction of safety, as appointed by the General Management of Air Algérie, has been tasked with establishing and ensuring the effective functioning of the SMS. [7]

In collaboration with IATA, the direction of safety developed an action plan to establish an efficient and operational SMS by September 2012. This plan involved:

Ensuring the implementation of safety policies at the level of Air Operations Department by conducting awareness campaigns.

Identifying performance indicators and setting safety objectives for the Air Operations Department.

Establishing a database management program for registering and archiving hazards, creating a safety library specific to the Air Operations Department.

Developing a data analysis process for identifying hazards and potentially dangerous conditions at the Air Operations Department.

Expanding the reactive data analysis process and the feedback loop process to ensure that initiators are informed of the analysis results.

Developing an annual evaluation plan (Proactive/Predictive) for 2012 and planning safety points at the level of the Air Operations Department with the relevant managers.

Reviewing and amending evaluation forms by adding criteria for safety responsibilities and performance for different operational staff at the Air Operations Department.

Planning meetings between the safety advisor, safety director, and flight safety manager to discuss progress and study the implementation rate of the SMS initiatives.

Documenting and implementing all completed initiatives. [9]

II.4.2:Safety Reporting Management Procedure:

This procedure outlines the methodology for managing safety reports related to Air Operations Department activities, including the analysis and treatment of these reports (Hazard Identification and Risk Analysis). The Safety Management System cell within the Air Operations Department (DOA) is responsible for carrying out this process.

The Operator shall have a hazard identification program in the flight operations organization that includes a combination of reactive and proactive methods of hazard identification.

The flight operations organization must have a safety risk assessment and mitigation program that specifies processes to ensure:

- Identification of hazards and their potential effects on flight operations;
- Analysis of safety risks resulting from the hazards;
- Development and implementation of appropriate risk mitigation measures when needed in the flight operations, to reduce or eliminate the safety risks associated with hazards. [1]

a) Safety Risk Management:

To ensure that the safety performance targets of aviation service providers are met, it is essential to manage safety risks through a process known as safety risk management. This process includes identifying potential hazards, assessing the safety risks associated with those hazards, and implementing appropriate mitigation measures.

Hazards can be the result of various factors, such as deficient systems, human error, or changes in the service provider's operating environment. By understanding these factors and analyzing them during the planning, design, and implementation phases, potential hazards can often be identified before the system becomes operational. [7]

Furthermore, hazards may be discovered during the operational life cycle of the aviation service provider, through employee reports or incident investigations. It is important to analyze these hazards in the context of the system, as attributing events to "human error" may neglect defects in the system, which could lead to more serious events in the future.

To ensure high safety performance, it is crucial to have a thorough understanding of the system and its operating environment. This understanding can help identify and manage hazards effectively, thus reducing the risks associated with aviation activities. [1]

b) Hazard identification:

- The organization will develop and maintain a process that ensures hazards during operations are identified.
- The identification of hazards will be based on a combination of reactive, proactive and predictive methods of collecting safety data.

Reactive methods involve responding to events that have already occurred.

Proactive methods involve seeking out potential hazards before they occur.

Predictive methods involve using data and analysis to anticipate future hazards.

To identify hazards, consider the following factors:

- Conceptual factors, such as equipment and task design.
- Operational procedures and practices, including their documentation and checklists.
- Communication, including the means of transmission, terminology, and language.
- Organizational factors, such as recruitment, training, compensation, and resource allocation policies.
- Environmental factors, such as noise, temperature, lighting, and availability of protective equipment and clothing.
- Regulatory factors, including the applicability and enforceability of regulations, equipment, personnel, and procedure certifications, and the adequacy of regulatory oversight.
- Means of defense, such as the availability of adequate detection and alert systems, equipment reliability and resistance to error.
- Human performance, including medical conditions and physical limitations of personnel.

By considering these factors, potential hazards can be identified, analyzed, and addressed to improve safety performance in aviation operations. [1]

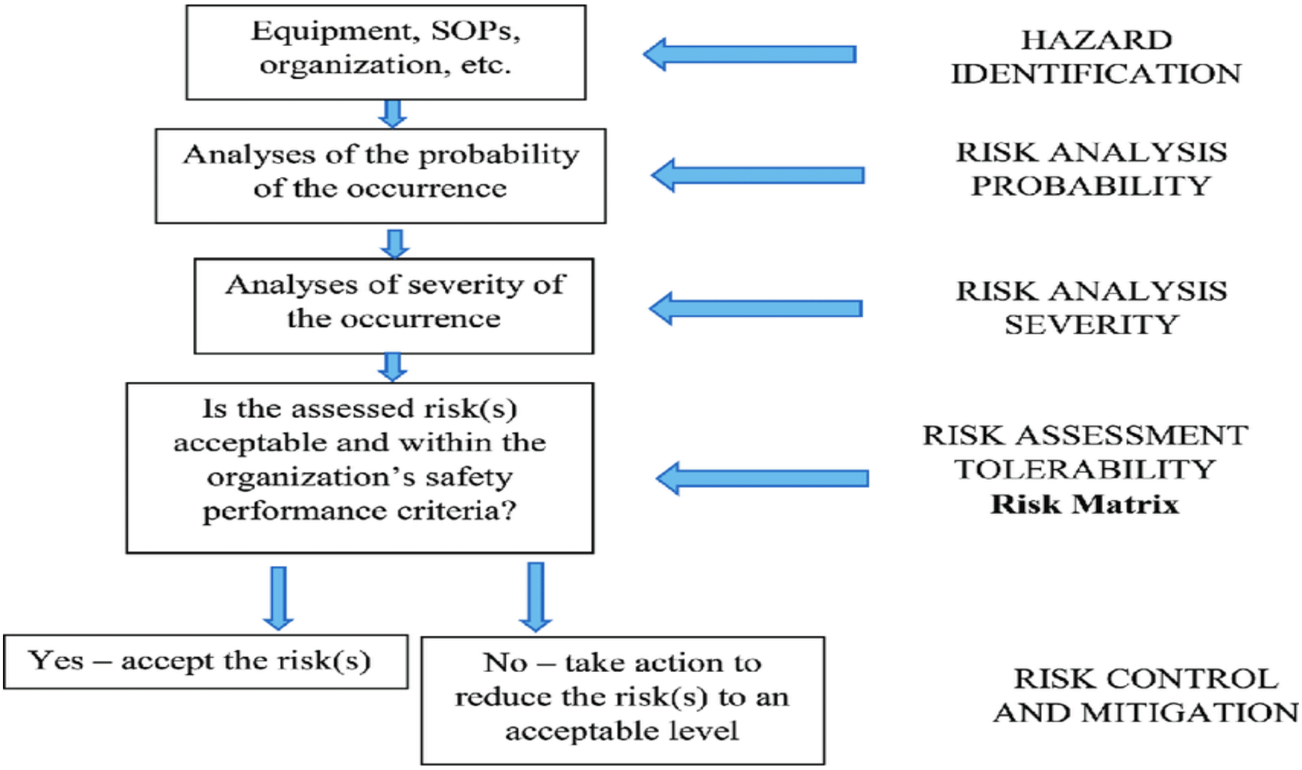


Figure II-2:The safety risk managemet process [1]

c) Safety risk assessment and mitigation:

Risk assessment involves determining the level of safety risk associated with the identified hazards. This phase helps identify good risk management practices.

When analyzing risks, the risk index is based on the evaluation of three factors:

The probability that a sequence of events will occur, resulting in a specific consequence.

The severity of the consequence for the decision maker.

The risk index is expressed as follows:

RISK = PROBABILITY × SEVERITY. [1]

Risk probability		Risk severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

[3]

Table II-1:Example of a safety risk (index) assessment matrix

II.5: Safety Assurance:

II.5.1:Safety performance monitoring and measurement:

The purpose of this section is to explain how each aviation service provider must comply with the circular that provides general guidelines for the establishment of Safety Management Systems.

The SMS should, at the very least, handle the maintenance of safety, notably by regular monitoring and evaluation of safety performance and changes that may impact it, with the goal of continuous improvement.

To accomplish this, the aviation service provider collects relevant information for monitoring those identified risk situations.

The service provider determines the level at which the indicator reveals an unwanted evolution.

The service provider describes the steps it takes to correct the occurrence of identified events, as well as the goals it establishes to validate the proper use of these measures. These findings should be compatible with the safety policy established by the upper-level manager. They are periodically examined to ensure that they are still relevant. [6]

The aviation service provider defines safety levels (i.e., safety performance) and expresses them in terms of various and complimentary safety performance indicators and targets, rather than single indicators and targets.

They are periodically reviewed to ensure that they are still relevant and fit for purpose.

The precise definition of relevant indicators and their monitoring will be completed in consultation with aviation service providers through the work meetings organized by the DACM during the implementation phase. [1]

SAFETY PERFORMANCE:

The organization's safety performance is verified using the following tools:

- Safety reports;
- Safety studies;
- Safety assessments;
- Audits;
- Surveys; and
- Internal safety investigations. [1]

SAFETY REPORTS:

Employees must report safety incidents and accidents using one of three defined reporting systems: mandatory, voluntary, or confidential.

a. Mandatory incident reporting system:

Mandatory incident reporting systems force personnel to report specific categories of incidents. To do this, precise regulations must be established regarding who must write the reports and which events must be reported. The large number of variables in aviation operations makes it difficult to give a comprehensive list of items or situations justifying a report. [5]

b. The voluntary incident reporting system:

States should implement voluntary incident reporting systems to supplement obligatory reporting. In such systems, the reporting party submits a voluntary incident report without any legal or administrative responsibility to do so. In a voluntary reporting system, regulators may offer rewards to report.

c. The confidential reporting system:

Confidential reporting systems aim to protect the reporter's identity, particularly for reports made under a non-punitive program. Typically, the initial recipient of the report deletes the author's identity to ensure confidentiality.

Confidential incident reporting systems enable the disclosure of human error without causing embarrassment among colleagues, while also allowing colleagues to learn from previous mistakes.

- In addition to what is specified in regulation texts, an aeronautical service provider can demand its personnel and subcontractors to produce safety reports for any sort of event.

  Effective safety reports often have the following characteristics:
  - Reporting is simple;
  - Reports submitted under the non-punitive reporting program do not result in disciplinary action.
  - Reports are kept confidential;
  - Feedback is timely, informative, and easily available. [1]

SAFETY AUDITS:

Aviation service providers must conduct safety audits in accordance with Art. 16 of the Circular on the General Rules for the Certification of Aeronautical Services. This guarantees adequate staff resources, compliance with approved procedures and instructions, and competence and training for equipment and facility use and performance levels.

SAFETY SURVEYS:

Safety surveys evaluate specific operations to identify faults, staff perceptions, and causes of uncertainty.

Safety surveys can be conducted using checklists, questionnaires, and confidential informal interviews.

Safety survey data is subjective; therefore, verification may be required before taking corrective action. [1]

INTERNAL SAFETY INVESTIGATIONS:

Internal safety investigations include events or incidents that are not required to be investigated or reported to the state; however, in some cases, aviation service providers may conduct internal investigations even if the event or incident in question is being investigated by the state.

Internal safety investigations cover several situations, such as in-flight turbulence, frequency congestion, equipment failure (aircraft maintenance), and ground vehicle operations at an airfield. [1]

II.5.2:The management of change:

Aviation service providers adopt a structured approach to detect organizational changes that may impact existing processes and services. This includes describing safety performance before implementing changes, Remove or alter safety risk measures that are no longer needed or effective due to changes in the operating environment. [6]

II.5.2.1 EXTERNAL AND INTERNAL CHANGES:

Changes might introduce new risks, endanger the adequacy of existing risk mitigation techniques, and/or reduce the effectiveness of existing security risk management strategies. Changes may come from outside or within the aeronautical service provider.

Examples of external changes:

- Changes to regulatory requirements;
- New safety requirements;
- Reorganization of air traffic control.

Examples of internal changes:

- Changes in management;
- Introduction of new equipment or a new service;

- Establishment of new procedures or modification of existing procedures. [1]

II.5.3:Continuous improvement of the SMS:

Safety assurance is based on the principle of the continuous improvement cycle; the organization must ensure control of safety performance, including regulatory compliance, through constant verification and modernization of the operating system.

Continuous improvement is achieved through proactive evaluation of facilities, equipment, documentation and procedures via audits and surveys, as well as proactive evaluation of personnel performance to verify compliance with their safety responsibilities, while ensuring reactive evaluation to verify the effectiveness of the control and risk mitigation system.

The organization must develop a formal process to identify and address under-performing circumstances, including determining their impact on SMS operations and eliminating or mitigating the underlying causes.

Air Algérie plans and implements SMS monitoring, measurement, analysis and improvement processes to:

- Ensure an acceptable level of flight safety.
- Ensure compliance of the safety management system.
- Continuously improve the effectiveness of the SMS.
- Ensure the effectiveness of the risk mitigation and control system.
- Improve personnel safety performance.
- Identify the causes of underperformance and their impact on the proper functioning of the SMS.
- Determining the implication of SMS underperformance in operations in order to eliminate or mitigate the causes of the decline in SMS performance.
- Verify the achievement of safety objectives. [1]

II.6: Safety Promotion:

Safety promotion is the process of sharing lessons learnt from safety event investigations and other safety-related actions to all parties involved.

It also serves as a technique of encouraging the development of a positive safety culture and ensuring that, once formed, this culture is maintained.

The company will create and maintain a safety training program to guarantee that employees are qualified and competent to carry out SMS functions; the range of safety training will be appropriate to each individual's involvement in the SMS. [1]

II.6.1:Training and education:

Each aviation service provider creates and maintains a safety training program to guarantee that employees are qualified and competent to execute SMS functions.

The degree of safety training is appropriate for each person's role in the SMS.

The safety manager, working with his departmental staff, must assist operational managers with writing and editing job descriptions for each employee with safety duties.

The Chief Executive Officer (CEO) allocates resources according to budget and plans structures for flight safety training, awareness-raising and maintenance.

The Operator's training and assessment program must be approved by the Authority and include ground and flight training, as well as reviews to ensure flight crew members are competent in their assigned roles. The program aims to provide traditional, advanced, alternative, and evidence-based training and qualification for all aircraft types in the fleet. [4]

The Operator should have a Training Manual for flight operations personnel, which can be issued in separate parts and includes all relevant training programs, policies, procedures, requirements, and other guidance needed to administer the Training Program.

- ❖ Safety management system training is provided to ensure:

- The application of current flight safety regulations.
- Maintaining staff awareness.
- The development of a fair aviation safety culture.

❖ The aviation safety training program aims to:

- Meet the requirements of Annex 06;
- Establish a fair safety culture.
- Meet the state's safety requirements [1]

II.6.2:Safety communication:

The organization establishes and maintains formal safety communication channels to ensure all personnel are aware of the safety management system, communicate critical information, explain reasons for measures, and explain changes to safety procedures. Communication channels may include policies and procedures, safety announcements, newsletters, and websites. [1]

II.7: Conclusion:

The use of Safety Management Systems (SMS) has become an integral part of aviation operations, with the goal of achieving continuous improvement in safety performance. By implementing effective SMS procedures, aviation organizations can identify and mitigate potential hazards, investigate incidents and accidents, and take corrective actions to prevent future occurrences.

As we have seen, SMS procedures are an essential tool for promoting safety in aviation operations. By adopting and maintaining a strong SMS, aviation organizations can reduce risks and ensure the safety of their operations.

CHAPTER III

REPORTING SYSTEM, DATABASE AND SAFETY INDICATOR MONITORING

CHAPTER III : REPORTING SYSTEM, DATABASE AND SAFETY INDICATOR MONITORING

III.1: Introduction:

In the dynamic and complex environment of air operations, the systematic collection, storage, and analysis of data play a critical role in maintaining and enhancing safety standards. Chapter 3 of this thesis focuses on the mechanisms and tools that underpin these processes, specifically the reporting systems, databases, and safety indicator monitoring frameworks. [2]

This chapter provides an in-depth exploration of the components and functionalities of these systems, emphasizing their importance in identifying potential hazards, tracking performance metrics, and facilitating continuous improvement within air operations. By leveraging robust reporting mechanisms and sophisticated databases, organizations can ensure that safety indicators are accurately monitored, thereby enabling proactive decision-making and risk mitigation.

The chapter begins by outlining the key features of reporting systems used in air operations, including the types of data collected and the methods employed for data submission and processing. It then delves into the structure and management of safety databases, discussing how these repositories are organized and utilized to support safety management systems (SMS). Finally, the chapter examines the various safety indicators that are monitored within these systems, highlighting the critical role they play in assessing the effectiveness of safety measures and identifying areas for improvement.

The analysis presented in this chapter is crucial for understanding how data-driven approaches contribute to the overall safety and efficiency of air operations, and how these systems can be optimized to enhance their effectiveness. [7]

III.1.1:SAFETY REPORTING AND INVESTIGATION :

III.1.2:Effective safety reporting:

Effective safety management is dependent on accurate and timely reporting of relevant information related to hazards, incidents or accidents. This information serves as the foundation for safety analyses, which inform safety initiatives and improve the overall safety culture of an organization.

One of the most valuable sources of data for safety management is front-line personnel, who are often in the best position to observe and report on potential hazards in their work environment.

For safety reporting to be effective, organizations must create a supportive culture where front-line personnel are encouraged to report their errors and experiences without fear of retribution. [7]

Effective safety reporting systems possess five essential characteristics, as outlined in Figure 1. Hazard reporting, a critical aspect of safety management, allows organizations to identify and analyze safety risks through the collection of relevant data. This data, when combined with information from other sources, supports the Safety Risk Management (SRM) and Safety Analysis (SA) processes.

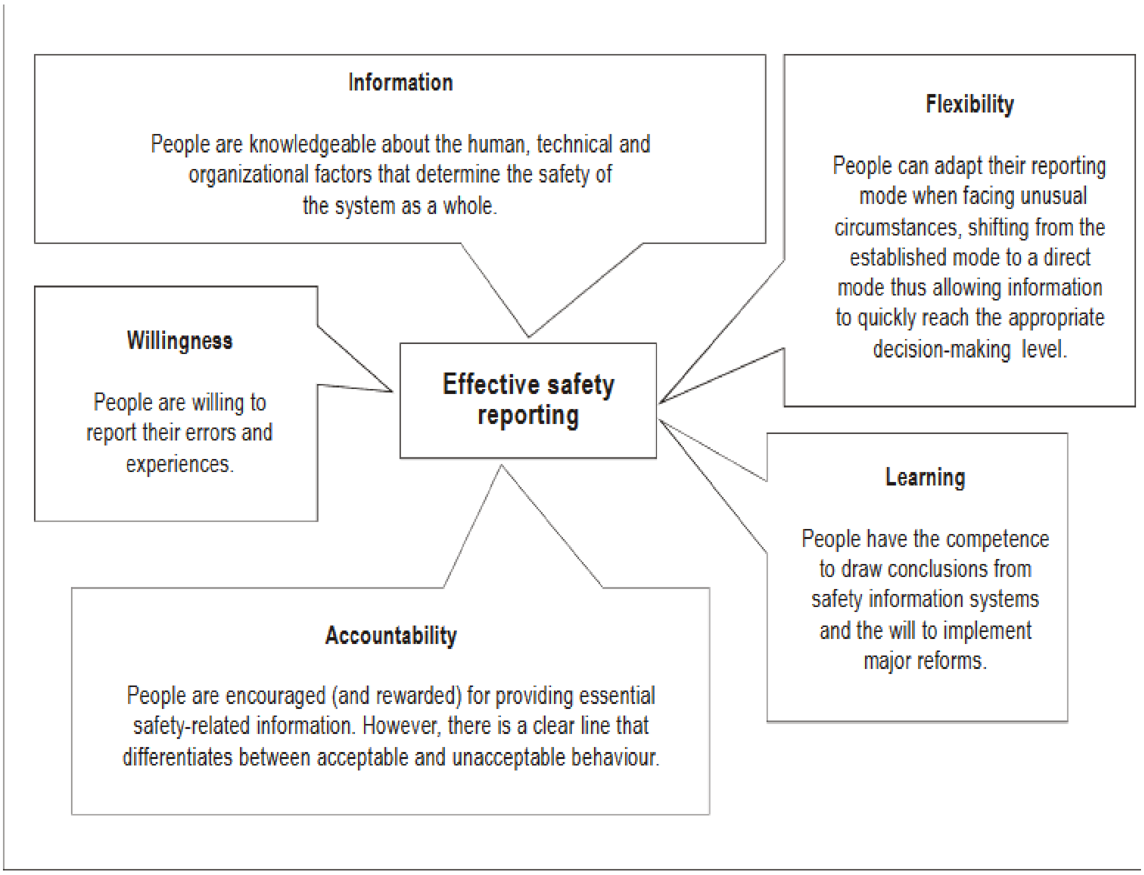


Figure III-1:Effective safety reporting — five basic characteristics

[1]

In addition to direct reporting from front-line personnel, another valuable data source for supporting SRM and SA processes is occurrence reporting. This encompasses a wide range of events, from high-consequence events (accidents and serious incidents), to lower-consequence occurrences such as operational incidents, system/equipment failures, and defects. [4]

While regulatory requirements often mandate the reporting of high-consequence occurrences, mature safety management environments also encourage the reporting of lower-consequence events.

A well-rounded reporting system should encompass both reactive and proactive/predictive elements. Reactive reporting (e.g., accident/incident reports) captures information on events that have already occurred, while proactive/predictive reporting (e.g., hazard reports) allows for the identification of potential hazards and risks that can be addressed before an event occurs.

Both types of reporting systems should include a clearly defined report format, appropriate confidentiality procedures, appropriate addressees (e.g., safety managers, regulatory authorities), investigation/evaluation procedures, corrective/preventive actions, and report dissemination.

a) The organization has a mechanism in place to record internal occurrences, such as accidents, incidents, and SMS-related incidents.

b) Mandatory reports (accidents, significant incidents, major flaws, etc.) must be reported to the CAA, although other routine occurrence reports remain within the organization.

c) There is also a voluntary and confidential hazard/occurrence reporting mechanism, which includes adequate identity/data protection where applicable.

d) The relevant reporting systems are simple, accessible, and appropriate for the size of the company.

e) High-impact reports and recommendations are directed to and considered by the appropriate level of management.

f) Reports are gathered in a suitable database to permit the necessary analysis. [1]

III.1.3:VOLUNTARY AND CONFIDENTIAL REPORTING SYSTEMS:

a) The objective of this reporting system:

The voluntary and confidential reporting system at air algérie aims to improve airworthiness by collecting reports on actual or potential flaws that may not be reported through other channels. These reports may include incidents, hazards or threats to the safety of our aviation operations. This method cannot replace the requirement for formal reporting of accidents and incidents according to our company's standard operating procedures, as well as the submission of mandatory occurrence reports to the appropriate regulatory authorities. [2]

The Air Algerie safety Reporting System is a confidential reporting system managed by the Safety Department of Air Algerie, which facilitates voluntary reporting of aviation occurrences or hazards by personnel of our organization, while ensuring the reporter's anonymity. [1]

Note:

When designing the safety reporting system, the organization must consider whether to integrate the Occupational Safety, Health and Environment (OSHE) reporting system with the aviation safety reporting system or keep them separate. This decision may depend on the requirements and expectations of both aviation and OSHE regulatory bodies.

If there is a separate OSHE reporting system within the company, this should be clearly communicated to personnel in this paragraph, so that they can correctly report aviation incidents and hazards. This ensures that the organization can accurately identify and address safety concerns in both the aviation and OSHE domains. [1]

b) the scope of the aviation sectors/areas covered by the system:

The Air Algerie Safety Reporting System encompasses a wide range of areas, including flight operations, hangar aircraft maintenance, workshop component maintenance, technical fleet management, inventory technical management, engineering planning, technical services, technical records, line maintenance, and more. The system provides a comprehensive mechanism for employees to report incidents, near-misses, and hazards in all these areas, contributing to the organization's overall safety management. [1]

c) who can make a voluntary report:

Voluntary reporting of aviation incidents, threats, and hazards is essential to improving aviation safety. Employees in the following operational areas or departments can contribute to our organization's safety management by reporting through the Air Algerie Safety Reporting System:

- Flight and cabin crew members;
- Air traffic controllers;
- Licensed aircraft engineers, technicians, or mechanics;
- Maintenance, design, and manufacturing organization employees;
- Airport ground handling operators;
- Aerodrome employees;
- General aviation personnel;
- etc. [1]

d) when to make such a report:

You should consider making a report through the Air Algerie Safety Reporting System when:

- You want to help others learn from an incident or hazard, but you're concerned about maintaining anonymity;
- No other suitable reporting procedure or channel is available;
- You've already tried other reporting procedures or channels, but the issue has not been addressed. [1]

e) how the reports are processed:

The Air Algerie Aviation Safety Reporting System ensures the protection of reporters' identities throughout the reporting process. Every report is read and validated by a manager or an alternate manager, who may contact the reporter for clarification or additional information. Once the information is deemed complete and coherent, it is de-identified and entered into the reporting system's database. If input from a third party is required, only de-identified information is shared.

Reports are returned to the reporter within ten working days, unless further input is needed.

De-identified reports may be shared internally and externally to support aviation safety improvement. If a report suggests an imminent or urgent threat to aviation safety, it will be prioritized, de-identified, and referred to relevant organizations or authorities so that appropriate safety actions can be taken. [1]

f) contacting the AIR Algerie safety report manager:

If a personnel member has any queries about the Air Algerie Safety Reporting System or would like to discuss a potential report with a manager before submitting, they may contact the Safety Reporting System Manager, or the Alternate Safety Reporting System Manager, during office hours from Monday to Friday, or leave a message with their respective offices. [1]

Figure III-2:Safety reporting system

III.1.4:Investigation of accidents and incidents:

When an accident or serious incident occurs in the aviation industry, a thorough investigation is initiated to identify the underlying causes and weaknesses in the aviation system. The accident investigation process serves as a vital part of the safety management environment, providing the means to examine safety defenses, barriers, checks, and counterbalances that may have failed.

By determining the root causes of accidents and serious incidents, the accident investigation process aims to generate countermeasures that will prevent similar incidents from occurring in the future.

As a critical element of both SMS and SSP, accident investigations play a vital role in the proactive improvement of aviation safety.

Through comprehensive analyses of accidents and incidents, these investigations provide root causes and valuable lessons learned. This information supports decision-making for the development of corrective actions, allocation of resources, and potential improvements to the aviation system, including SMS, SSP, and the State accident investigation process.

While mandatory State-level investigations are typically limited to accidents and serious incidents, a mature safety management environment may include investigations of lower-consequence events as well.

Accident/incident investigations do not only provide findings and root causes of accidents/incidents but also reveal potential hazards/threats that, if left unchecked can lead to future accidents or incidents.

A comprehensive investigation process includes the identification and differentiation between the ultimate consequence (the accident or incident), the unsafe event (the immediate cause of the accident or incident), and the contributing hazards/threats that may be systemic, latent, or organizational in nature.

In today’s proactive safety management environment, the integration between the accident/incident investigation process and the organization’s hazard reporting/identification process is crucial.

Accident/incident investigation reports should have a clear provision for documenting hazards/threats uncovered during the investigation, which may require separate follow-up action by the organization's hazard identification and risk mitigation processes. Without such a provision, secondary or indirect hazards/threats may be overlooked, leading to potential safety risks in the future. [1]

III.2: SAFETY DATA COLLECTION AND ANALYSIS:

III.2.1:Safety data collection and quality:

Data-driven decision-making is a crucial aspect of any management system. Organizations must collect various types of safety data, including accidents, incidents, non-conformances, and hazard reports. The quality of this data is vital for effective decision-making and should be a primary consideration throughout the development and implementation of Safety Management Systems (SMS) and SSP initiatives. Unfortunately, many databases do not meet the necessary quality standards, which can hinder the evaluation of safety priorities and the effectiveness of risk mitigation strategies. Ignoring the limitations of data used in safety risk management and assurance can lead to flawed analyses and poor decision-making, ultimately undermining the safety management process. [7]

Given the significance of data quality, organizations should evaluate the data supporting safety risk management and assurance processes against the following criteria:

- Validity: Data must meet established criteria for its intended use.
- Completeness: All relevant data should be included, with no critical information missing.
- Consistency: Measurements should be reproducible and free from errors.
- Accessibility: Data should be readily available for analysis.
- Timeliness: Data must be relevant to the specific time period and available promptly.
- Security: Data should be protected against unauthorized or accidental alterations.
- Accuracy: Data must be free from errors.

By adhering to these seven criteria, organizations can ensure that their safety data analyses yield the most accurate information possible, thereby supporting informed strategic decision-making. [1]

III.2.2:Safety database:

The term "safety database" refers to data or information that can support safety analysis, including accident investigation data, mandatory and voluntary reporting data, airworthiness data, operational monitoring data, safety risk assessment data, audit reports, and more. Safety databases can be managed by States (for SSPs) or service providers (for SMSs) and may include data from various sources, such as personnel, passengers, and the general public. [10]

Safety databases contain complex reports, such as accident and incident reports, which answer questions like who was involved, when, where, and why. They also have simpler reports on topics like flight information, weather, and traffic volumes.

Many organizations provide access to their databases through an interface, allowing safety analysts to specify and extract reports of interest. Analytical tools allow safety analysts to view extracted data in different formats, like spreadsheets, maps, and graphs.

To ensure appropriate usage of the database, its metadata, or data about the data, should be well-documented and easily accessible to users. Metadata includes information on field definitions, changes over time, usage rules, data collection forms, and valid values.

To improve aviation safety analysis, integration facilities should be established to extract information from multiple sources, apply common data standards, consolidate metadata, and load the information onto a centralized platform. This will provide aviation safety analysts with a more comprehensive view of safety issues.

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

[1]

Table III-1:Example SMS gap analysis and implementation task identification plan

Once the safety data have been processed, they become accessible to safety analysts through a unified interface and a consistent set of analytical tools. If an analyst needs data from multiple databases, the use of standardized data formats allows database technicians to extract the necessary information and compile a new, comprehensive database.

Figure 3 illustrates a state's safety data system, including inputs, procedures, and outputs for collecting, analyzing, and exchanging data. [1]

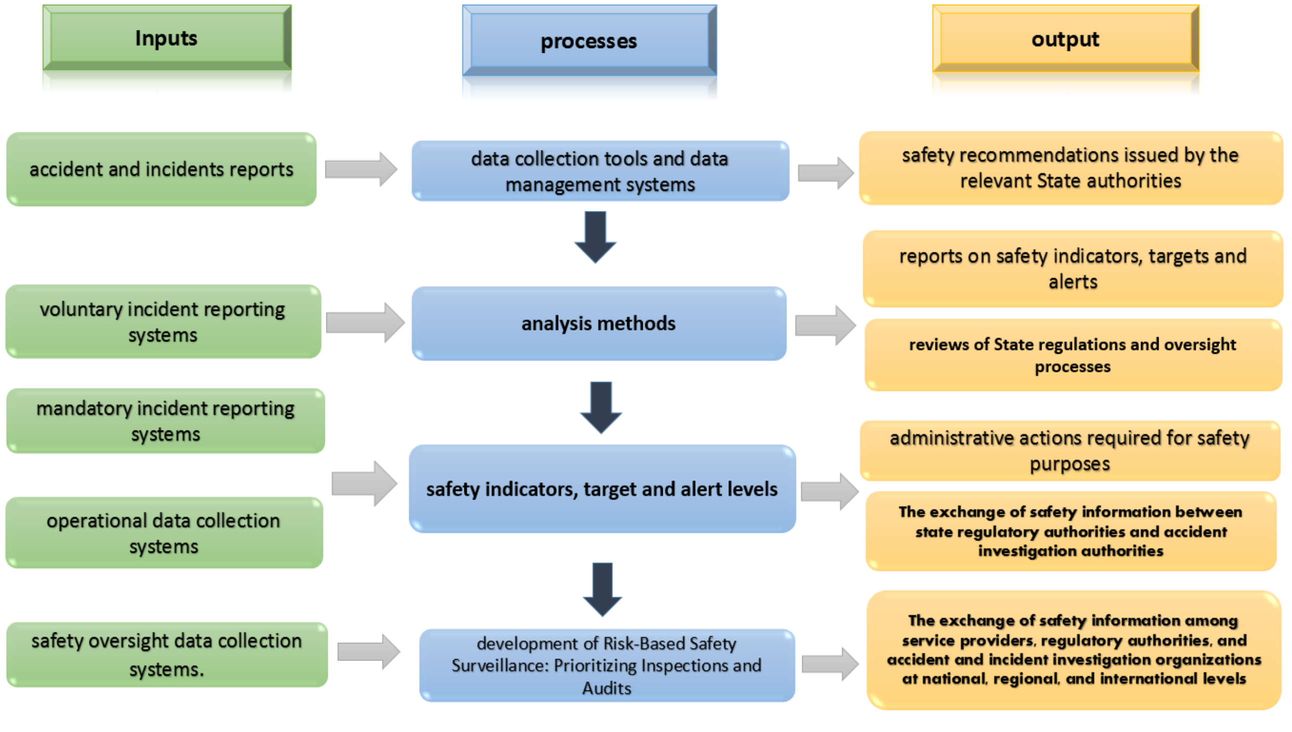


Figure III-3:. Schematic view of a state's safety data system

III.2.3:Safety data analysis:

Safety data collection from various sources is just the first step. Organizations should then analyze the collected data to identify potential hazards and control their consequences. The analysis can be used for various purposes, such as:

a) Determining what additional information is required to better understand safety concerns.

b) Identifying hidden factors that may be causing safety deficiencies.

c) Helping to reach valid conclusions based on the data.

d) Monitoring safety trends and performance to identify areas that may require improvement.

The process of safety analysis can be ongoing, requiring multiple rounds to refine results. It can involve either quantitative (numerical) or qualitative (non-numerical) data. Without existing quantitative baseline data, qualitative methods may be necessary.

It's important to recognize that human judgement is susceptible to bias, often influenced by past experiences. One common form of bias is "confirmation bias," where people tend to seek out and remember information that supports their existing beliefs, potentially leading to flawed interpretations or hypotheses. [1]

Analytical methods and tools:

The following safety analysis methods can be used:

a) Statistical analysis: This method helps to determine if a trend in the data is statistically significant, meaning it's unlikely to have occurred by chance. Graphs can help visualize the trends, but data quality and analytical methods should be carefully considered to avoid incorrect conclusions.
b) Trend analysis: By monitoring trends in safety data, predictions can be made about future events. Trends may indicate the emergence of new hazards, allowing for proactive management of safety risks.
c) Normative comparisons: If sufficient data isn't available to compare potential events, it may be necessary to compare real-world experience under similar operating conditions.
d) Simulation and testing: In some cases, hazards may become apparent through computer simulations or laboratory testing. These tests can validate the safety implications of existing or new operations, equipment, or procedures.
e) Expert panel: A diverse team of experts can provide valuable insights on potential hazards related to an unsafe condition. Their collective knowledge can help determine the most effective corrective action.
f) Cost-benefit analysis: The cost of implementing safety risk control measures is compared to the benefits they will provide over time. Sometimes, accepting the consequences of a safety risk may be more tolerable than the cost and effort of implementing corrective action. [1]

III.2.4:Management of safety information:

Effective safety management relies on data-driven decision-making. Therefore, proper management of organizational databases is essential for effective safety analysis.

Various commercially available electronic databases are affordable and can support the organization's data management needs. These databases provide a powerful tool for personnel monitoring system safety issues and spotting potential safety hazards.

An organization's safety data management system should be tailored to meet its specific size and complexity needs. Generally, the system should:

- Have an easy-to-use interface for data entry and query.
- Have the ability to process large amounts of safety data into useful information for decision making.
- Reduce the workload for managers and safety personnel.
- be cost-effective and not require large investments.

To fully utilize the benefits of safety databases, it’s essential to have a basic understanding of how they function. While any organized collection of information can technically be considered a database, analyzing paper records kept in a basic filing system is only practical for small operations. Managing storage, recording, recall, and retrieval with paper-based systems can be cumbersome. Ideally, safety data should be stored in an electronic database that allows for easy querying of records and generating analysis outputs in various formats.

When selecting a database management system, it's important to analyze the many functional qualities and attributes available. Basic features should allow users to log safety events, link related documents, monitor trends, compile analyses, check historical records, share data with other organizations, monitor event investigations, and track corrective actions. [1]

III.2.5:Protection of safety data:

To prevent exploitation of safety data gathered strictly for aviation safety purposes, database management must prioritize data protection. Database managers have to achieve a balance between protecting data and providing access to those who can improve aviation safety. To protect safety data, consider the following factors:

a) Whether current regulations provide adequate protection for safety data while still allowing for its use in advancing aviation safety;

b) Implementing organizational policies and procedures that limit access to safety data to only those who have a legitimate need for it;

c) Removing any details from safety data that could potentially be used to identify individuals, such as flight numbers, dates/times, locations, and aircraft type;

d) Ensuring that information systems, data storage, and communication networks are secure and protected against unauthorized access;

e) Establishing clear prohibitions on the unauthorized use of safety data, with appropriate consequences for violations.

By addressing these factors, database managers can help protect the confidentiality and integrity of safety data while still allowing it to be used to improve aviation safety.

The safety record of international civil aviation can be attributed to constant learning and information exchange. Accident and incident investigations provide objective data that can be used to improve equipment design, maintenance, flight crew training, air traffic control systems, airport design, and meteorological services. Technological advances have hastened the development of safety data collection and processing systems (SDCPS).

SDCPS has improved understanding of operational errors in aviation, focusing on minimizing their occurrence and containing their negative impact on safety. Most errors are inadvertent, but enforcement systems exist for rare cases of reckless or willful misconduct. This dual approach, combining enhanced understanding with law enforcement, has improved safety in civil aviation and prevented violators from harboring.

In recent years, there has been a troubling trend in civil aviation, where information obtained from safety data collection and protection systems (SDCPS) has been misused for disciplinary, enforcement, and even judicial purposes. This includes using the data to bring criminal charges against individuals involved in occurrences resulting from inadvertent operational errors.

Such misuse of safety data is counterproductive to improving aviation safety, as it can discourage the reporting of occurrences and the free exchange of safety information. By punishing individuals for making honest mistakes, we may inadvertently create a culture of silence and fear, which can have serious consequences for aviation safety.

Addressing the misuse of safety data is a delicate and complex issue that requires careful consideration and cooperation within the international civil aviation community. While various initiatives have been attempted, it is clear that a cohesive and consistent framework is needed to effectively protect safety information.

In developing such a framework, it is essential to strike a balance between protecting safety information, maintaining quality control, managing safety risks, and ensuring justice is administered fairly. Any proposals must also be mindful of the varied legal systems and traditions of different contracting states, as interfering with their ability to administer justice could undermine the effectiveness of the framework.

To mitigate the misuse of safety data, ICAO developed Attachment E to Annex 13, which provides legal guidance to help States create national laws and regulations that protect safety information collected from safety data collection and protection systems (SDCPS). These regulations should also allow for the fair administration of justice.

The aim is to prevent the inappropriate use of safety data gathered solely for the purpose of enhancing aviation safety. The legal guidance takes the form of principles, which States can adapt to suit their individual needs and circumstances, while ensuring the harmonization of international civil aviation standards.

The legal guidance aims to protect safety information for its continued availability, facilitating preventive actions and improving aviation safety. It doesn't interfere with justice administration, strikes a balance between information protection and justice administration, prevents inappropriate use, and is part of a state's safety responsibilities under specific conditions.

The guidance outlines principles for protecting safety information from inappropriate use, requiring specific conditions for each SDCPS, establishing a formal procedure for protection, ensuring information is used for its intended purpose, and ensuring its use in disciplinary, civil, administrative, and criminal proceedings under suitable safeguards. [1]

Safety information collected from SDCPS systems may not be protected in the following circumstances:

a) Evidence suggests that the occurrence was caused intentionally or recklessly, which is considered a crime under the law;

b) An appropriate authority has reasonable grounds to suspect that the occurrence may have been caused intentionally or recklessly;

c) An appropriate authority determines that releasing the safety information is necessary for the proper administration of justice and outweighs the negative domestic or international impact on the future availability of safety information.

The guidance emphasizes the importance of public disclosure of safety information, stating that anyone seeking it should justify its release, based on formal criteria. It provides recommendations for public disclosure, with the following conditions:

a) Disclosure of safety information is justified if it is necessary to correct safety hazards or change safety policies and regulations.

b) Disclosure of safety information does not impede its future availability for the improvement of safety.

c) Disclosure of personal information contained in safety information complies with applicable privacy laws.

d) If necessary, safety information should be de-identified, summarized or aggregated to protect the confidentiality of individuals involved.

The legal guidance emphasizes the responsibility of the custodian of safety information. Each SDCPS should have a designated custodian who has the following responsibilities:

a) To ensure the protection of safety information by limiting its disclosure unless the originator consents to the release of the information or;

b) To ensure that any exception to the principle of protection is in accordance with the principles of exception.

Additionally, the guidance recommends the protection of ambient workplace recordings, such as cockpit voice recorders (CVRs). Given that these recordings may infringe upon the privacy of operational personnel, the following measures are proposed:

a) Ambient workplace recordings required by legislation should be considered privileged protected information, deserving enhanced protection, in accordance with the principles of protection and exception outlined above.

b) National laws and regulations should provide specific measures of protection for such recordings in terms of confidentiality and access by the public.

Despite the adoption of guidance for the protection of safety data collection and protection systems (SDCPS) in 2006, the aviation community felt that further progress was necessary to ensure the availability of safety data and information for the enhancement of aviation safety. In response, the ICAO Assembly in 2010 instructed the Council to consider enhancing the provisions on the protection of safety information.

Consequently, in 2011, the ICAO Air Navigation Commission established the Safety Information Protection Task Force (SIP TF), with the objective of developing new or enhanced provisions and guidance material related to the protection of safety information. [1]

III.3: SAFETY INDICATORS AND PERFORMANCE MONITORING:

The data analysis from a safety data collection and analysis system is often presented visually in the form of charts and graphs, which provide a "snapshot" of the analysis of safety information gathered at a particular time.

While such visualizations are commonly used in quality/reliability management systems, their role in safety management systems is to provide timely insights into safety-related issues and trends. These charts and graphs serve as an important communication tool, enabling decision-makers to quickly identify areas of potential safety concern and take necessary actions to mitigate risks.

Figure 4 displays a basic (screen shot) data analysis chart that shows the number of mandatory occurrence report (MOR) incidents for each fleet type of an operator in the year 2009. However, this chart fails to provide context by neglecting to show the number of aircraft for each fleet type or the number of flights undertaken by each fleet type.

As a result, the chart offers limited usefulness in understanding the safety performance of each fleet type. This type of chart falls short of providing an accurate reflection of safety trends, making it inadequate for use as a continuing safety performance indicator.

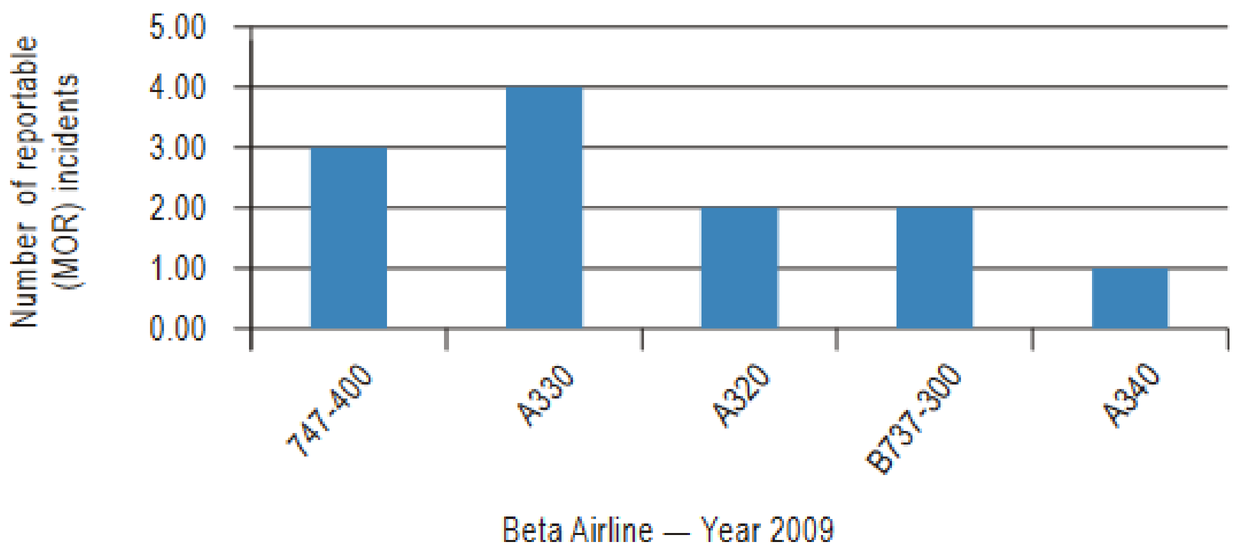


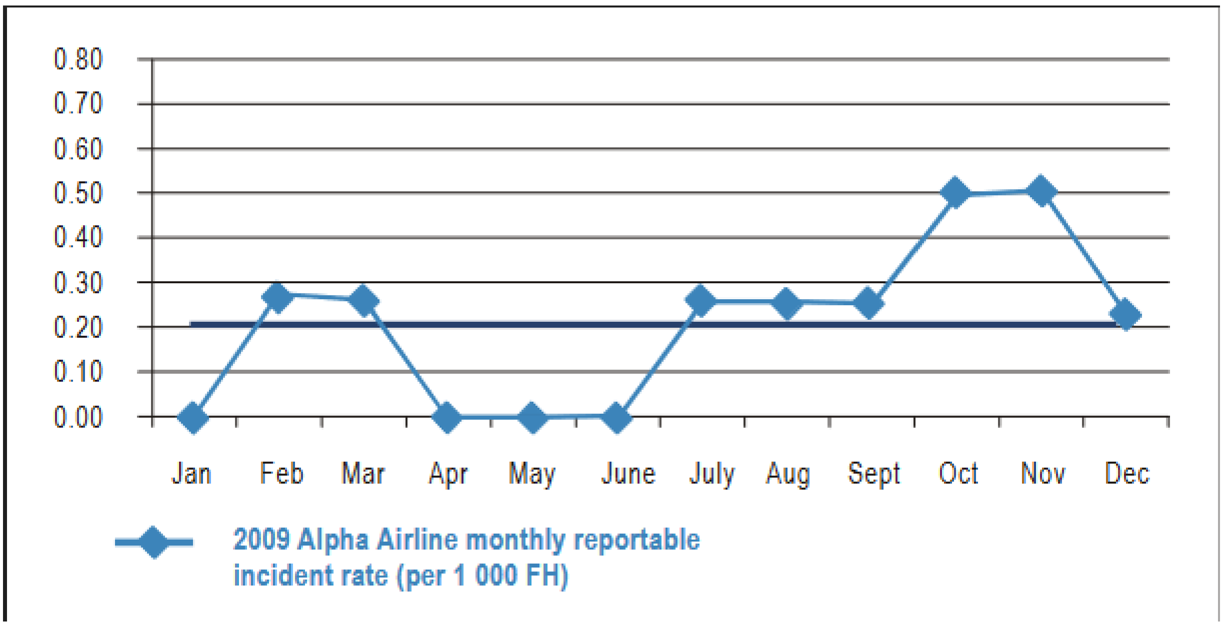
Figure III-4:A basic (screen shot) data analysis chart [1]

Continuous monitoring of safety requires periodic data extraction and analysis to generate trend charts or graphs updated on a monthly or quarterly basis. As seen in Figure 5, this chart displays the monthly reportable incident rate normalized against the accumulated flying hours (FH) for the operator's fleet.

By uploading the incident rate data periodically, the trend monitoring indicator chart can be continuously updated, allowing for more informed decision-making and performance analysis.

Once a trend monitoring indicator chart is established, the next step is to transform it into a safety performance measurement indicator. This involves setting target and alert levels based on historical data points to define unacceptable alert trend levels and desired improvement levels to be achieved within a specified period.

By doing so, organizations can effectively monitor their safety performance over time and identify areas for improvement. This continuous analysis of safety data can then be used to inform and guide safety risk management decisions and strategies, helping to prevent incidents and accidents, and ultimately promoting a safer and more resilient aviation industry. [1]



[1]

Figure III.5. A continuous monitoring safety indicator chart

III.3.1:SMS SAFETY PERFORMANCE INDICATORS :

Tables 2 provide examples of State aggregate safety performance indicators (SPIs) along with corresponding alert and target level setting criteria. The SPIs specific to safety management systems (SMS) are listed on the right-hand side of the tables. These indicators should be developed in consultation with State regulatory organizations to ensure they align with the State's overall safety performance indicators (SSP), which are depicted on the left-hand side of the tables.

The proposed SPIs by product and service providers must be in agreement with the State's SSP indicators.

It's essential that product and service providers and regulatory organizations collaborate to establish safety performance indicators that align with the State's safety objectives. This harmonization ensures that the safety performance of individual organizations contributes to the broader safety performance of the State and promotes a shared responsibility for safety within the aviation industry.

Regular monitoring and evaluation of these indicators will enable the identification of safety trends, the establishment of performance targets, and the implementation of corrective actions where necessary. This in turn enhances the overall effectiveness of the safety management system and improves the safety culture within the industry. [1]

SSP safety indicators (aggregate State)						*SMS safety performance indicators (individual service provider)*					
High-consequence indicators (occurrence/outcome-based)			*Lower-consequence indicators (event/activity-based)*			*High-consequence indicators (occurrence/outcome-based)*			*Lower-consequence indicators (event/activity-based)*		
Safety indicator	*Alert level criteria*	*Target level criteria*	*Safety indicator*	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*	*Safety performance indicator*	*Alert level criteria*	*Target level criteria*
Air operators (air operators of the State only)											
CAA aggregate air operator monthly/quarterly accident/serious incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	CAA aggregate air operator annual surveillance audit LEI % or findings rate (findings per audit)	Consideration	Consideration	Air operator individual fleet monthly serious incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator combined fleet monthly incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate
CAA aggregate air operator quarterly engine IFSD incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	CAA aggregate air operator annual line station inspection LEI % or findings rate (findings per inspection)	Consideration	Consideration	Air operator combined fleet monthly serious incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator internal QMS/SMS annual audit LEI % or findings rate (findings per audit)	Consideration	Consideration
			CAA annual foreign air operator ramp surveillance inspection average LEI % (for each foreign operator)	Consideration	Consideration	Air operator engine IFSD incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate	Operator voluntary hazard report rate (e.g. per 1 000 FH)	Consideration	Consideration
			CAA aggregate operator DGR incident report rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate				Operator DGR incident report rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	__% (e.g. 5%) improvement between each annual mean rate
etc.											

Table III-2:Examples of safety performance indicators for air operators. [1]

Table 5-A6-5 (example of an SMS safety performance indicator chart) shows an airline operator's reportable/mandatory incident rate as a high-consequence SMS safety performance indicator. The chart on the left displays the operator's performance from the previous year, while the right-hand chart displays the most recent updates from the current year. [7]

The alert level is determined using the basic safety metrics standard deviation criteria, calculated using either the Excel function "STDEVP" or the manual formula:

$$\sigma = \sqrt{\frac{\sum(X-\mu)^2}{N}}$$

Where "X" is the value of each data point; "N" is the number of data points and "µ" is the average value of all the data points. This formula allows organizations to calculate the standard deviation of their safety performance data, which can provide insights into the variability of their performance and

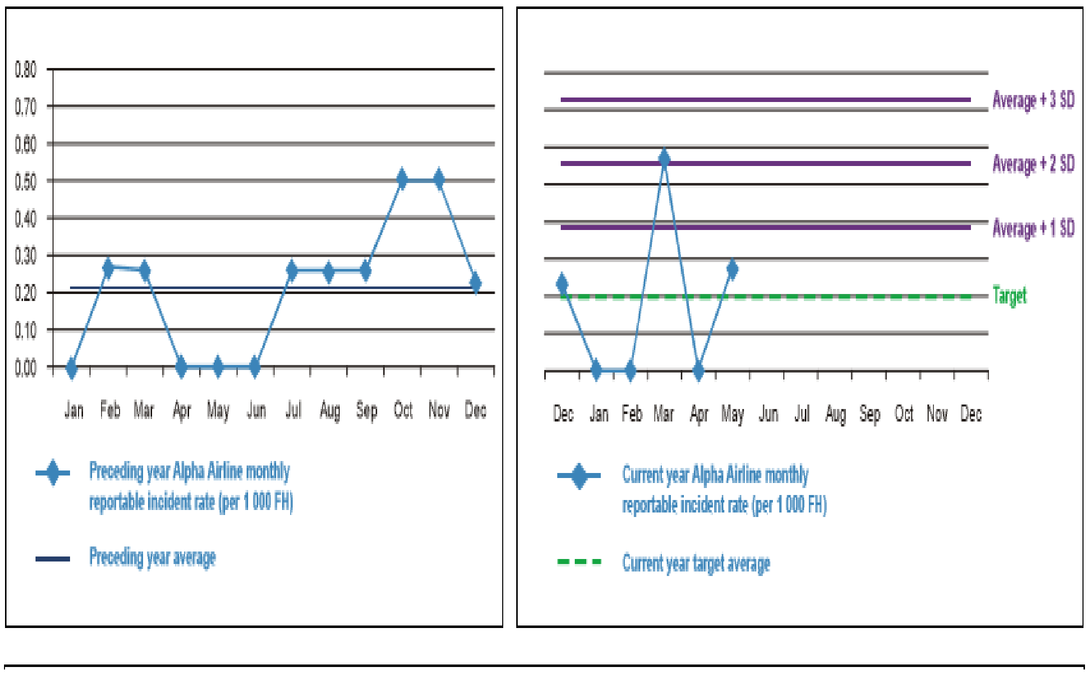


Figure III-5: Example of an SMS safety performance indicator chart (with alert and target level settings)

[1]

potential outliers. Once the standard deviation has been calculated, the organization can determine appropriate alert levels based on the criteria established in their safety management system.By monitoring and analyzing these indicators on a regular basis, organizations can identify areas for improvement, implement corrective actions, and track the effectiveness of their safety management system over time. [1]

a) Alert level setting:

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

b) Alert level trigger:

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

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

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

c) Target level setting (planned improvement):

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

d) Target achievement:

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

e) Alert and target levels — validity period:

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

Table 3 serves as a data sheet to generate the safety performance indicator chart displayed in figure3. The target setting of 5% improvement over the previous year's data point average is applied to create the indicator chart.

The same data sheet can be utilized for other safety performance indicators as well, with the relevant data entries and amendments to the safety performance indicator descriptor. This approach allows for a flexible and adaptable means of monitoring and analyzing various safety indicators, contributing to a more comprehensive and effective safety management system. [1]

Preceding year				
Month	*Alpha Airline total FH*	*Number of reportable/MOR incidents*	*Incident rate**	*Average*
January	3 992	—	0.00	0.21
February	3 727	1.00	0.27	0.21
March	3 900	1.00	0.26	0.21
April	3 870	—	0.00	0.21
May	3 976	—	0.00	0.21
June	3 809	—	0.00	0.21
July	3 870	1.00	0.26	0.21
August	3 904	1.00	0.26	0.21
September	3 864	1.00	0.26	0.21
October	3 973	2.00	0.50	0.21
November	3 955	2.00	0.51	0.21
December	4 369	1.00	0.23	0.21
		Average	0.21	
		SD	0.18	

Average + 1 SD	Average + 2 SD	Average + 3 SD
0.39	0.56	0.73

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

* Rate calculation (per 1 000 FH).

Current year							
Month	*Alpha Airline total FH*	*Number of reportable/ MOR incidents*	*Incident rate**	*Preceding year average + 1 SD*	*Preceding year average + 2 SD*	*Preceding year average + 3 SD*	*Current year target average*
December	4 369	1.00	0.23	0.39	0.56	0.73	0.21
January	4 090	0.00	0.00	0.39	0.56	0.73	0.20
February	3 316	0.00	0.00	0.39	0.56	0.73	0.20
March	3 482	2.00	0.57	0.39	0.56	0.73	0.20
April	3 549	0.00	0.00	0.39	0.56	0.73	0.20
May	3 633	1.00	0.28	0.39	0.56	0.73	0.20
June				0.39	0.56	0.73	0.20
July				0.39	0.56	0.73	0.20
August				0.39	0.56	0.73	0.20
September				0.39	0.56	0.73	0.20
October				0.39	0.56	0.73	0.20
November				0.39	0.56	0.73	0.20
December				0.39	0.56	0.73	0.20
		Average					
		SD					

Current year target is say 5% average rate improvement over the average rate for the preceding year, which is:	0.20

Table III-3:Sample data sheet used to generate a high-consequence SMS safety indicator [1]

Table 4 (an example of an SMS performance summary) presents a consolidated overview of all the operators' SMS safety indicators, with annotations for their respective alert and target level outcomes. This summary can be compiled at the end of each monitoring period to provide a snapshot of SMS performance. For a more quantitative assessment, points can be assigned to each Yes/No outcome corresponding to each target and alert outcome. For example:

High-consequence indicators:

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

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

Lower-consequence indicators:

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

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

This may allow a summary score (or percentage) to be obtained to indicate the overall SMS safety performance at the end of any given monitoring period. [1]

High-consequence safety performance indicator					
	SPI description	*SPI alert level criteria (for 2010)*	*Alert level breached (Yes/No)*	*SPI target level criteria (for 2010)*	*Target achieved (Yes/No)*
1	Alpha Airline's A320 fleet monthly serious incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	5% improvement of the 2010 average rate over the 2009 average rate	No
2	Alpha Airline's A320 fleet engine IFSD incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	3% improvement of the 2010 average rate over the 2009 average rate	Yes
3	etc.				

Lower-consequence safety indicators					
	SPI description	*SPI alert level criteria (for 2010)*	*Alert level breached (Yes/No)*	*SPI target level criteria (for 2010)*	*Target achieved (Yes/No)*
1	Operator combined fleet monthly incident rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	Yes	5% improvement of the 2010 average rate over the 2009 average rate	No
2	Operator internal QMS annual audit LEI % or findings rate (findings per audit)	More than 25% average LEI or any Level 1 finding or more than 5 Level 2 findings per audit	Yes	5% improvement of the 2010 average rate over the 2009 average rate	Yes
3	Operator voluntary hazard report rate (e.g. per 1 000 FH)	TBD		TBD	
4	Operator DGR incident report rate (e.g. per 1 000 FH)	Average + 1/2/3 SD (annual or 2 yearly reset)	No	5% improvement of the 2010 average rate over the 2009 average rate	Yes
5	etc.				

Table III-4:: Example of Alpha Airline's SMS safety performance measurement (say for the year 2010)

[1]

Apart from the SMS level safety indicators discussed previously, various operational areas within an organization may utilize other system level indicators to monitor specific processes or systems. These indicators could be associated with engineering, operations, quality management systems, fatigue risk management, or fuel management, for instance.

Although these process or system-specific indicators should be handled within the respective system or process manuals or standard operating procedures (SOPs), it is recommended that the criteria for setting alert or target levels for these indicators align with the criteria used for the SMS level safety performance indicators, where feasible.

Organizations are encouraged to tailor the selection of safety indicators (both high and lower-consequence) to align with the scope of their system. If any suggested alert or target level setting criteria are not applicable, alternate criteria should be considered.

Generally, the alert and target levels are set based on recent historical or current performance of the indicators. This approach ensures that the levels are realistic and achievable, promoting a continual improvement in safety performance over time. [1]

III.3.2:The Role and Importance of Safety Indicators and Performance Monitoring in Aviation Safety Management Systems:

Safety indicators and performance monitoring are crucial aspects of safety management systems (SMS) as they provide a practical means of measuring safety performance, identifying trends, and enabling organizations to proactively address safety risks.

Some key reasons why safety indicators and performance monitoring are important:

- They help organizations gain a better understanding of their safety performance and measure progress towards safety objectives.
- They enable organizations to take proactive actions to address potential safety risks, rather than waiting for accidents or incidents to occur.
- They provide a common language and framework for discussing safety performance across different organizational levels and disciplines.

The use of safety indicators and performance monitoring also promotes a culture of safety within an organization by fostering an environment where safety is actively monitored and discussed. This, in turn, helps organizations to identify and address safety concerns quickly and efficiently, reducing the likelihood of accidents or incidents.

Moreover, the results of safety indicator monitoring can be shared among different organizations and industry stakeholders, contributing to a broader understanding of safety issues and best practices across the aviation industry. This collaboration ultimately improves the safety of aviation operations and protects passengers, crew, and the public. [11]

III.4: Conclusion:

Safety reporting, database management, and safety indicator monitoring are fundamental building blocks in the development of a comprehensive and sustainable Safety Management System (SMS) within the aviation industry.

Reporting systems, whether voluntary or mandatory, provide the raw material for effective safety data collection and analysis, while safety databases act as repositories for this information, ensuring its accessibility and integrity for subsequent risk analysis and trend monitoring. Meanwhile, safety indicator monitoring enables continuous evaluation of safety performance, allowing organizations to identify potential safety issues before they evolve into major incidents or accidents.

CHAPTER IV

EVALUATION PROCESS OF THE LEVEL OF IMPLEMENTATION OF SMS COMPONENTS AND ELEMENTS WITHIN THE DOMAIN OF AIR OPERATIONS (OPS AER).

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IV.1: Introduction:

The evolution of aviation safety management has progressively shifted from a purely compliance-based approach to a more nuanced, performance-based oversight framework. This transition is central to the International Civil Aviation Organization's (ICAO) Annex 19, which promotes a standardized approach to Safety Management across various aviation domains. The primary objective of Annex 19 is to ensure a consistent and systematic application of safety management principles both at the State level and within aviation organizations.

To support this harmonized approach, the Safety Management International Collaboration Group (SM ICG) has developed the Safety Management System (SMS) Evaluation Tool. This tool serves as a key instrument in assessing the overall effectiveness of SMS implementations, focusing not only on compliance but also on performance. The evaluation is conducted through a series of indicators derived from ICAO Annex 19 and the ICAO Safety Management Manual (Doc 9859). These indicators are organized within the ICAO SMS Framework, providing a comprehensive structure for the assessment process.

The SMS Evaluation Tool enables organizations to evaluate whether specific SMS components are Present, Suitable, Operating, and Effective, using clearly defined criteria. This methodology represents a significant advancement in safety oversight, emphasizing the practical performance of SMS in real-world operations rather than merely its adherence to regulatory standards.

This chapter will delve into the application of the SMS Evaluation Tool, exploring its role in advancing a performance-based oversight model. By analyzing the tool's effectiveness in evaluating SMS within the context of flight operations, cabin operations, dispatch, and training, this chapter aims to provide a thorough understanding of how this approach contributes to the enhancement of aviation safety. [8]

IV.2: A Path to Safety: Continuous Evaluation of SMS Effectiveness Using the SMS Evaluation Tool:

The SMS Evaluation Tool can be utilized in various stages of the safety management process by both regulatory authorities and organizations.

During initial certification or implementation, regulatory authorities can verify whether all SMS processes are present and suitable, assuring that all necessary components of a functioning SMS are implemented by the organization. This process can include a desktop review of SMS documentation, as well as providing guidance and support for the organization's SMS implementation.

When it comes to ongoing surveillance, regulatory authorities should allow sufficient time for the organization's SMS to mature before evaluating whether the processes are present, suitable, and operating.

The next important consideration is when an organization's SMS processes become mature and move to operating and effective.

At this stage, the regulatory authority may need to revisit the suitability of SMS processes to ensure that they are still appropriate, given any changes that have occurred in the organization's approval or significant changes within the organization itself.

This continuous monitoring of SMS processes ensures that both regulatory authorities and organizations can effectively evaluate and improve the effectiveness of safety management systems over time, ultimately leading to safer and more efficient aviation operations.

Surveillance activities such as routine compliance audits, inspections, occurrence investigations, and meetings with the organization can provide valuable insight into the effectiveness of the SMS.

In addition, accreditation for meeting industry standards may be a testament to an organization's adherence to best practices and can be taken into account when evaluating SMS effectiveness. [8]

By considering a range of surveillance activities and accreditations, regulatory authorities can gather a comprehensive view of an organization's SMS, ultimately leading to more effective oversight and improved safety performance. [5] [11]

Organisation:	**Approval/Certificate Reference(s):**	
SMS or MS Manual Revision:	**Evaluator(s) (Name and Department):**	
Scope of Evaluation:	**Date of Evaluation:**	**Evaluation Reference:**

Figure IV-1SM ICG SMS Evaluation Tool

[9]

IV.3: Comprehensive Oversight through SMS Evaluation and Surveillance Integration:

To effectively utilize the SMS evaluation tool, it is important for regulatory authorities to consider the following:

Integrate the results of the SMS evaluation with other data and information, such as surveillance activities and accreditations, to create a comprehensive picture of an organization's safety management system.

Apply the "one organization, one evaluation" principle when an organization has multiple certificates or approvals. If all activities are integrated under a single SMS, the evaluation should consider the SMS as a whole. [11] [5]

IV.4: Customizing the Evaluation Tool for Safety Management Systems:

The evaluation tool is designed in accordance with the SMS Framework outlined in Annex 19, but it prioritizes Safety Risk Management as the initial component, reflecting its significance as the cornerstone of an organization’s Safety Management System (SMS). This adjustment emphasizes the importance of this component during evaluations. Additionally, a new section on interface management has been included to align with the provisions of Annex 19. However users of the tool have the flexibility to customize the order of components to match the structure of Annex 19. They can begin with any component based on the availability of personnel or resources, or to address specific concerns. [3]

Customization options for users include:

- Aligning with organizational requirements
- Adhering to national SMS standards or terminology
- Responding to specific needs identified through the State Safety Program (SSP)

The layout of the tool is accompanied by a legend that clarifies the purpose of each section. [5] [11]

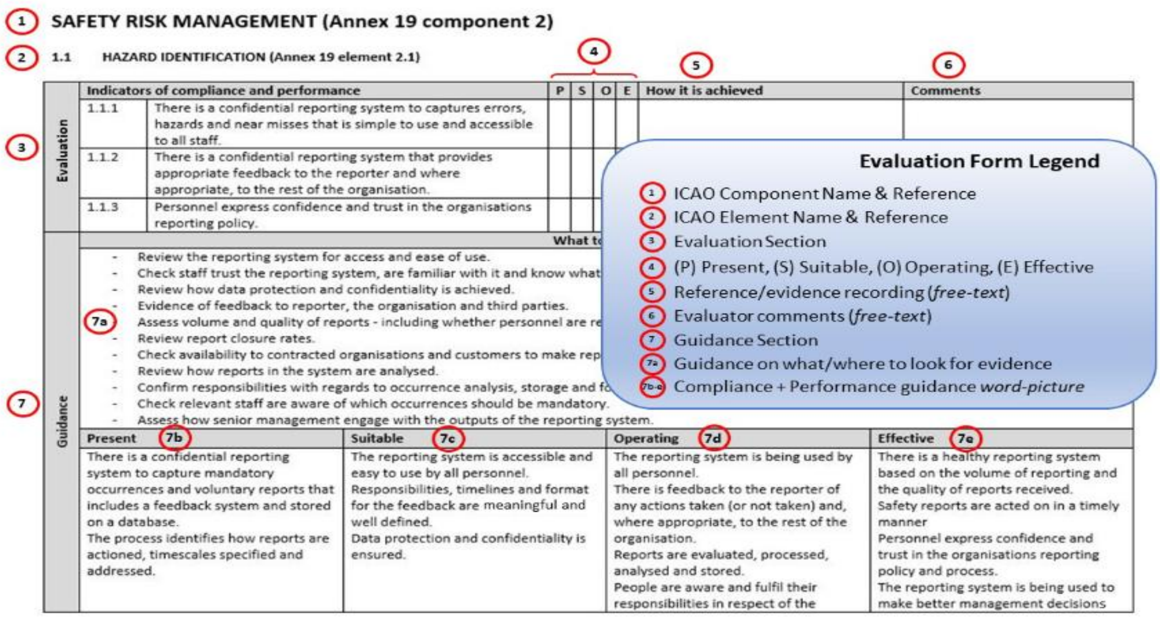

Figure IV-2:Example of evaluation form **[11]**

Definitions used in the tool:

The Definitions section in the tool provides clarity on the different ratings for each indicator:

Present (P): The relevant indicator is documented in the organization's SMS documentation.

Suitable (S): The relevant indicator is appropriate for the size, nature, and complexity of the organization and its inherent risks.

Operating (O): There is evidence that the indicator is in use and producing an output.

Effective (E): There is evidence that the indicator is achieving the desired outcome and having a positive impact on safety.

During initial approval or certification, organizations should strive for their indicators to be both Present and Suitable. During ongoing or subsequent evaluations, Suitable should be re-evaluated to account for any changes to the organization and its activities.

It is important to note that an indicator cannot be considered Operating or Effective if it is not Present. Furthermore, an indicator cannot be considered Present if it is not documented, as documentation ensures consistency and allows for repeatable and systematic results.

The "What to look for" section provides guidance for evaluators when assessing each individual feature. [11]

Level of detail to be recorded:

It is critical that the evaluator document proof of the evaluation. Documentation, reports, and interview and conversation transcripts are all examples of evidence. For example, for an item to be labeled Present, the evidence is likely to be documented alone, whereas for an item to be designated Operating, the assessment may include examining records as well as face-to-face interactions with employees within an organization. [11]

Addressing findings and observations:

When conducting an initial evaluation or assessing an organization's transition to new SMS requirements, all processes must be both Present and Suitable for the approval or certificate to be granted or the transition to be accepted. Once the SMS is functioning and the transition period has expired, if a process is found not to be Operating during the evaluation, a finding should be issued.

If a feature is found not to be Effective, issuing an observation may be appropriate to suggest improvements, but findings should not be issued if the process is Operating but not Effective.

Following the completion of the evaluation tool, the Regulatory Authority should provide the organization with a report that includes any findings and observations. This report should also include detailed comments to assist the organization in continuously improving their SMS, as this supports the development of a positive safety culture at the State level.

Providing feedback to organizations is crucial in promoting a cooperative relationship between the Regulatory Authority and industry, fostering open communication and collaboration on safety issues. By working together to address safety concerns, aviation stakeholders can strengthen the effectiveness of their safety management systems and improve safety outcomes. [11]

Scoring the SMS evaluation:

The primary goal of the Evaluation Tool is to provide a consistent and reliable framework for assessing the maturity and effectiveness of SMS, rather than assigning a numerical score.

While scoring the SMS evaluation may be tempting for Regulatory Authorities, the SM ICG does not recommend this approach due to the potential adverse effects on safety culture.

If a scoring system is to be implemented, it should not be linear but weighted or exponential, emphasizing the importance of achieving the Effective level in processes. This would encourage organizations to prioritize continuous improvement.

Regulatory Authorities must be mindful that scoring can create undesirable behaviors in organizations, such as a focus on achieving a certain score rather than genuinely improving safety performance.

To foster a positive safety culture, the evaluation should be used as a benchmark to compare maturity levels across the industry and identify areas for improvement, rather than a pass/fail criterion.

Regular communication with industry stakeholders is vital to provide feedback on their SMS and discuss areas for improvement. This collaborative approach helps to strengthen relationships and ensures that safety remains the top priority for all organizations. [11]

Training considerations:

The application of the SMS evaluation tool requires inspectors and their managers to possess specific competencies and skills, including knowledge of SMS, auditing techniques, interviewing and communication skills, risk management, compliance vs. performance, report writing, safety culture, human factors, and State Safety Programme and State Safety Objectives.

To ensure effective use of the tool, Regulatory Authorities should provide comprehensive training in these areas. This training should include classroom instruction, as well as on-the-job training during a live evaluation. [11]

Standardisation:

It is critical that the SMS evaluation tool is utilized consistently. A team-based SMS evaluation can achieve this goal. The regulator should standardize the evaluation tool utilized by its inspectors. This will discover inconsistencies in the approach and potential areas for extra training. To evaluate SMS effectiveness, use a combination of desktop reviews, follow-up activities, and on-the-job observations. [11]

Evaluation summary:

The tool was created to evaluate the maturity and effectiveness of the SMS in a uniform manner. To provide an overview of SMS success, organizations should produce a brief evaluation summary that represents their progress. [11]

	Initiating	Present and Suitable	Operating	Effective	Excellence
The SMS as a Whole	The SMS is at the implementation stage.	All main elements of the SMS are in place.	The systems and processes of the SMS are operating.	The SMS is working in an effective way and is striving for continuous improvement.	The organisation is an industry leader and embraces and shares its best practices.
Safety Risk Management	The safety risk management processes are not fully developed.	A safety reporting system is in place and there is a process for how risks are assessed and managed.	The hazard and risk registers are being built up and risks are starting to be managed in proactive manner.	The organisation is continuously identifying hazards and understands its biggest risks and is actively managing them; this can be seen in their safety performance. Safety Risk Management is proactive.	Key personnel throughout the organisation are aware and understand the risks relative to their responsibilities and are continuously searching out new hazards and risks and re-evaluating existing risks.
Safety Assurance	Safety assurance activities, including safety performance indicators (SPIs) are not fully developed.	Initial SPIs linked to the safety objectives have been identified and there is a change management process in place.	The organisation has established SPIs that it is monitoring and is auditing and assessing its SMS and its outputs.	The organisation assures itself that is has an effective SMS and is managing its risk through audit, assessment, and monitoring of its safety performance.	The organisation is continuously assessing its approach to safety management and is continuously improving its safety performance and seeking out and embracing best practices.
Safety Policy and Objectives	Policies, processes, and procedures are not fully developed.	There are policies, processes, and procedures in place that detail how the SMS will operate.	There is a safety policy in place and senior management are committed to making the SMS work and is providing appropriate resources to safety management.	Senior management are clearly involved in the SMS and the safety policy sets out the organisation's intent to manage safety. This is clearly evident in day to day operations.	The organisation is an industry leader and embraces best practices.
Safety Promotion	Safety promotion activities are not fully developed.	There is a training programme and the means to communicate safety information is in place.	The organisation has trained its people and has several mediums for safety promotion that it uses for passing on safety information.	The organisation puts considerable resources and effort into training its people and publicising its safety culture and other safety information and monitors the effectiveness of its safety promotion.	In addition, the organisation provides training and safety promotion to its contracted service providers and assesses the effectiveness of its safety promotion.
Human Factors Management	Human Factors are considered but not formally captured by the organisation.	Human Factors policies and processes have been defined and documented where required by regulation.	Human Factors are being managed across the organisation and are starting to be integrated into the organisation's SMS.	Human Factors are integrated into the SMS and the operations of the organisation. All staff including management are aware of Human Factors and apply it in the way they work.	Human Factors are embedded into the day to day activities of the organisation and fully integrated into the SMS. This is evident throughout the organisation from senior management to front line staff.

Table IV-1:Example of an evaluation summary [11]

Note:

- In addition to Present, Suitable, Operating, and Effective, this example uses two additional maturity levels: Initiating and Excellence.
- A specific line for Human Factors has also been added in this example to highlight the importance of considering Human Factors as part of the SMS. [11]

IV.5: Evaluation process:

IV.5.1:Objective Définitions :

In air operations we should assess and evaluate the effectiveness of SMS services in supporting flight crew, cabin crew, dispatch, and training operations with the following objectives:

1. Determine the efficiency of SMS services in ensuring regulatory compliance, adherence to best practices, and safety promotion in flight crew, cabin crew, dispatch, and training operations.
2. Examine the impact of SMS's services on overall aviation safety, including identifying potential areas of improvement.
3. Provide recommendations to enhance the effectiveness of SMS services in these areas, promoting greater safety and efficiency in aviation operations. [3]

Note: Clearly define what you aim to achieve through data collection. This might include evaluating compliance with regulatory standards, assessing safety culture, identifying gaps in the SMS, or measuring the effectiveness of safety processes.

IV.5.2:Scope Identification :

In air operations, we will consider the following areas in our evaluation of SMS services in flight crew, cabin crew, dispatch, and training operations:

1. Flight Crew: Assess SMS's support for pilot training, flight planning, and operational procedures to ensure regulatory compliance and safety.
2. Cabin Crew: Analyze SMS's contribution to cabin crew training, safety management, and emergency response protocols.
3. Dispatch: Examine SMS's role in ground operations, such as flight scheduling, aircraft maintenance, and fuel management.
4. Training: Review SMS's involvement in aviation training programs across all areas of flight crew, cabin crew, and ground operations, including their impact on safety culture, skill development, and compliance with training standards. [3]

Note: Determine the specific aspects of flight operations, crew operations, dispatch, and training that will be evaluated. For example, are you focusing on hazard identification, risk management processes, safety reporting, or training effectiveness?

Figure 2 provides an example of hazard identification evaluation tool guidance. [11]

Evaluation	Indicators of compliance and performance		P	S	O	E	How it is achieved	Comments
	1.1.4	There is a process that defines how hazards are identified from multiple sources through reactive and proactive methods (internal and external).						
	1.1.5	The hazard identification process identifies human performance related hazards.						
	1.1.6	There is a process in place to analyse safety data and safety information to look for trends and gain useable management information.						
	1.1.7	Safety investigations are carried out by appropriately trained personnel to identify root causes (why it happened, not just what happened).						

Guidance	What to look for

	- Review how hazards are identified, analysed, addressed, and recorded.
	- Review structure and layout of hazard log.
	- Consider hazards related to:
	  o Possible accident scenarios;
	  o Human and organisational factors;
	  o Business decisions and processes;
	  o Third party organisations; and
	  o Regulatory factors.
	- Review what internal and external sources of hazards are considered such as safety reports, audits, safety surveys, investigations, inspections, brainstorming, management of change activities, commercial and other external influences, etc.
	- Review whether safety investigations identify human and organisational contributing factors.

Present	Suitable	Operating	Effective
There is a process that defines how hazards are identified though reactive and proactive methods. The triggers for safety investigations are identified.	Multiple sources of hazards (internal and external) are considered and reviewed, as appropriate. The data analysis process enables gaining useable safety information. Hazards are documented in an easy-to-understand format. The level of sign-off for safety investigations is defined and adequate to the level of risk.	The hazards are identified and documented. Human and organisational factors related to hazards are being identified. Safety investigations are carried out and recorded.	The organisation has a register of the hazards that is maintained and reviewed to ensure it remains up-to-date. It is continuously and proactively identifying hazards related to its activities and the operational environment and involves all key personnel and appropriate stakeholders including external organisations. Hazards are continuously assessed in a systematic and timely manner. Safety investigations identify causal/contributing factors that are acted upon.

Table IV-2 hazard identification evaluation tool guidance.

[11]

IV.5.3:Establish Evaluation Criteria:

Before embarking on the evaluation of the SMS components and elements, an aviation company must first undertake a comprehensive assessment of their existing SMS framework, with a specific focus on identifying any gaps in implementation. This can be divided into three main steps:

SMS Baseline Assessment:

Documentation Review: Analyze existing SMS documentation, such as policies, procedures, manuals, and audit records, to ensure they reflect current practices and comply with regulatory requirements (e.g., ICAO, FAA, EASA).

Regulatory Compliance: Assess the organization's compliance with relevant regulatory standards, including understanding the specific SMS components and elements required by these regulations. (Which we already explained in the second chapter).

Personnel Identification: Determine key personnel responsible for SMS implementation within the organization, including the SMS Manager, safety officers, and other relevant stakeholders, ensuring that their roles and responsibilities are well-defined.

Cultural Assessment: Evaluate the current safety culture within the organization, including management commitment to safety, employee engagement in safety practices, and overall attitude towards safety and risk management.

Gap Analysis: Perform a gap analysis by comparing the organization's current SMS framework against the regulatory standards and best practices, identifying any areas where implementation is deficient.

Prioritization: Based on the gap analysis, prioritize areas that require improvement, including updating policies, enhancing training programs, or improving communication channels within the organization.

Objective Setting: Define clear objectives for the evaluation, such as assessing compliance, improving safety performance, or preparing for external audits, and develop an evaluation plan that includes the scope, methodology, timeline, and resources required.

By thoroughly understanding the current state of their SMS and identifying any gaps, the company can set the stage for a more effective and targeted evaluation of SMS implementation. This approach ensures that the evaluation will be comprehensive, focusing on both compliance and continuous improvement.

Before moving forward with the evaluation, it is essential to ensure that all relevant personnel have been briefed on the evaluation plan and their role in the process. This will ensure that all stakeholders are aware of the objectives and expectations of the evaluation, and that they can contribute effectively to the process. [3]

IV.5.4:Data Collect :

1. **Identifying Data Sources :**

- **Flight Operations**: Data can include flight logs, incident/accident reports, audit results, safety reports, and feedback from pilots and other flight crew members.
- **Crew Operations**: Collect data on crew scheduling, fatigue management, crew training records, crew performance assessments, and safety communications.
- **Dispatch**: Gather data on dispatch procedures, communication logs, weather-related incidents, and compliance with dispatch regulations.
- **Training**: Include data from training programs, curricula, instructor evaluations, trainee feedback, and records of safety training exercises.

2. **Data Collection Methods:**

The "Collect Data" phase of the SMS evaluation process refers to the stage of gathering relevant information from different sources to assess the effectiveness of the implemented SMS.

During this phase, evaluators should collect data from various sources such as:

- Surveys and Questionnaires
- Safety Reporting Systems
- Interviews with management, employees, and stakeholders.
- SMS documentation (policies, procedures, reports, etc.).
- Records of safety incidents, accidents, and near misses.
- External audits and assessments.

The data collected should cover all aspects of SMS implementation, including safety culture, risk management, safety assurance, safety promotion, and safety performance monitoring. [1] [3]

To assess the effectiveness of SMS implementation in flight operations, data should be collected and analyzed across various areas, including:

Flight Operations:

- Collect data on flight schedules, crew duty time, pilot qualifications, and dispatch procedures.
- Interview pilots, flight attendants, and ground crews to understand their perspectives on safety procedures and practices.
- Review flight records, maintenance logs, and incident reports.

Crew Operations:

- Interview cabin crew members and supervisors to assess their understanding of safety procedures and their confidence in reporting safety concerns.
- Collect data on crew training records, rest requirements, and work schedules.

Dispatchers:

- Evaluate dispatch procedures and training, including familiarity with flight rules, weather analysis, and aircraft performance.
- Review dispatch records, such as flight plans, weather briefings, and flight tracking data.

Training:

- Observe training sessions and assess the content, delivery, and effectiveness of safety training.
- Review training records and assessment results to evaluate learning outcomes.
- Interview trainers and trainees to understand their experiences with safety training. [3]

IV.5.5:Analyze Implementation :

The phase of analyzing implementation in the evaluation of a Safety Management System (SMS) is critical for assessing how effectively the SMS has been integrated into an organization's operations. This phase involves several systematic steps aimed at evaluating both compliance and performance, ensuring that safety objectives are met and identifying areas for improvement.

Key Components of the Analysis Phase:

1. **Performance Metrics Evaluation:**

During this phase, organizations should establish and review performance metrics that measure the effectiveness of the SMS. These metrics may include:

- **Safety Performance Indicators (SPIs)**: Quantitative measures that help assess safety performance over time.
- **Compliance Checks:** Evaluating adherence to regulatory requirements and internal safety policies.
- **Incident and Hazard Reports:** Analyzing data from safety reports to identify trends and areas needing attention.

2. **Utilization of Evaluation Tools:**

The use of structured evaluation tools, such as the Safety Management International Collaboration Group (SM ICG) SMS Evaluation Tool, provides a standardized approach to assessing SMS effectiveness. This tool focuses on four key principles: Present, Suitable, Operating, and Effective (PSOE):

- **Present:** Verification that relevant safety indicators are documented within the SMS.
- **Suitable:** Assessment of whether the indicators are appropriate for the organization’s size and complexity.
- **Operating:** Evidence that the indicators are actively in use and producing outputs.
- **Effective:** Evaluation of whether the indicators achieve the desired safety outcomes and positively impact safety performance.

3. Gap Analysis:

Conducting a gap analysis is essential to identify discrepancies between the current state of the SMS and the desired state. This involves:

- **Identifying Current Capabilities:** Understanding existing safety management practices and resources.
- **Defining Optimal State:** Establishing what an effective SMS should look like based on regulatory requirements and industry best practices.
- **Assessing Gaps:** Determining where the organization falls short and what specific actions are needed to bridge these gaps.

4. Data Analysis and Reporting:

Analyzing collected data is vital for understanding SMS performance. This includes:

- **Trends Identification:** Looking for patterns in safety incidents or compliance issues over time.
- **Root Cause Analysis:** Investigating the underlying causes of safety issues to prevent recurrence.
- **Reporting Findings:** Compiling results into comprehensive reports for stakeholders, including management and regulatory bodies, to inform decision-making and resource allocation.

5. Continuous Improvement:

The analysis phase should culminate in recommendations for continuous improvement. This involves:

- **Action Plans:** Developing targeted action plans to address identified weaknesses or gaps.
- **Feedback Loops:** Establishing mechanisms for ongoing feedback from staff and stakeholders to refine the SMS continually.
- **Re-evaluation:** Regularly revisiting the analysis process to adapt to changes in operations, regulations, or safety challenges.

The analysis phase of SMS implementation evaluation is a structured process that focuses on assessing performance, compliance, and areas for improvement. By utilizing performance metrics, evaluation tools, conducting gap analyses, and committing to continuous improvement, organizations can enhance their safety management practices and ultimately improve safety outcomes. [1] [11] [3]

IV.5.6: Findings Report :

The findings report is an essential component of the SMS evaluation process. It summarizes the results of the evaluation and presents a comprehensive overview of the current safety performance, identifying areas for improvement.

The findings report should:

- Outline the processes and metrics assessed during the evaluation.
- Highlight areas where SMS implementation is effective and areas where improvements are needed.
- Present data-driven evidence to support findings and recommendations.
- Propose specific and actionable recommendations for addressing identified weaknesses.

The findings report serves as a roadmap for organizations to enhance their SMS and achieve optimal safety performance.

The "Findings Report" phase is a critical juncture in the evaluation of SMS implementation across flight operations, crew operations, dispatch, and training. During this phase, the collected and analyzed data is synthesized into a comprehensive report, which summarizes the SMS's effectiveness, identifies areas for improvement, and suggests actionable steps for enhancement in each operational area. [3]

This report provides a valuable tool for stakeholders to assess the current state of safety management and to prioritize improvements for enhanced safety performance.

Here’s how this phase unfolds:

Flight Operations: The findings report for flight operations should summarize the results of the analysis, including any areas for improvement. Findings might include recommendations to:

- Revise crew scheduling to reduce fatigue risks.
- Enhance incident reporting systems to increase reporting frequency and effectiveness.
- Strengthen crew resource management training and procedures.

Crew Operations: The findings report for crew operations should Discuss findings related to crew operations, including safety culture, adherence to safety protocols, and the effectiveness of fatigue management and training.

Dispatch: Findings for dispatch may include the quality of dispatch procedures, communication effectiveness, and how well safety management is integrated into dispatch activities.

Training: Findings for training must provide insights into the effectiveness of safety-related training programs, training compliance, and the impact of training on safety performance. [10]

IV.5.7:Implement Improvements :

The phase of implementing improvements in the evaluation of Safety Management System (SMS) implementation is a critical step that focuses on applying the findings from previous evaluations to enhance safety practices across various operational areas, including flight operations, crew operations, dispatch, and training. This phase ensures that the SMS evolves continuously to meet safety objectives and regulatory requirements. [9]

Key Components of the Implement Improvements Phase:

1. **Action Plan Development:**

Based on the findings from the evaluation phase, organizations must develop a detailed action plan that outlines specific improvements to be made. This includes:

- Identifying Improvement Areas: Clearly defining which aspects of the SMS need enhancement, such as training effectiveness, hazard reporting processes, or compliance with safety protocols.
- Setting Objectives: Establishing measurable objectives for each improvement area to track progress and effectiveness.
- Resource Allocation: Determining the necessary resources, including personnel, training materials, and technology, to implement the improvements effectively.

2. Engagement and Communication:

Successful implementation of improvements requires active engagement and communication with all stakeholders, including management and staff. This involves:

- Involving Staff: Encouraging input from employees at all levels to foster a sense of ownership and commitment to the SMS improvements. This can be achieved through workshops, meetings, or feedback sessions.
- Transparent Communication: Keeping all stakeholders informed about the changes being made, the reasons behind them, and how they will impact operations. This helps in reducing resistance to change and enhancing buy-in.

3. Training and Support:

To ensure that all personnel are equipped to adapt to the new processes and procedures, comprehensive training programs must be implemented:

- Training Programs: Developing targeted training sessions that address the specific areas of improvement identified in the evaluation. This may include safety protocols, risk management practices, and the use of new reporting tools.
- Ongoing Support: Providing continuous support and resources for staff as they adapt to the changes, including access to mentors or safety officers who can assist with questions and concerns. [3]

4. Monitoring and Feedback Mechanisms:

- Continuous monitoring and feedback are essential to evaluate the effectiveness of the implemented improvements:
- Performance Monitoring: Establishing metrics and indicators to assess the impact of the improvements on safety performance. This includes tracking incident rates, compliance levels, and employee engagement in safety practices.
- Feedback Loops: Creating mechanisms for staff to provide feedback on the changes, which can help identify any issues or areas that require further adjustment. Regular check-ins and surveys can facilitate this process. [9] [11]

5. Internal and External Audits:

Conducting audits is vital to ensure that the improvements are being effectively integrated into the SMS:

- Internal Audits: Regular internal evaluations should be conducted to assess the implementation of improvements and their alignment with safety objectives.
- External Audits: Engaging third-party auditors can provide an objective assessment of the SMS improvements, ensuring compliance with regulatory standards and identifying additional areas for enhancement.

6. Continuous Improvement Cycle:

The implementation of improvements should be viewed as part of a continuous improvement cycle:

- Review and Adaptation: Regularly reviewing the effectiveness of the improvements and making necessary adjustments based on performance data and feedback.
- Long-term Commitment: Establishing a culture of continuous improvement within the organization, where safety is prioritized, and ongoing enhancements to the SMS are expected and supported. [11]

This phase is essential for translating evaluation findings into actionable changes that enhance safety across flight operations, crew operations, dispatch, and training. By developing a structured action plan, engaging stakeholders, providing training, and establishing monitoring mechanisms, organizations can ensure that their SMS remains effective and responsive to safety challenges. [3]

IV.5.8: Follow-Up :

The follow-up process involves:

Monitoring progress: Regular monitoring of progress in implementing improvements ensures that actions are taken on schedule and issues are promptly addressed.

Assessing effectiveness: Assessments should be conducted to determine whether improvements are effective in addressing identified weaknesses and achieving desired outcomes.

Effective follow-up in the SMS evaluation process includes:

Measuring effectiveness: Quantitative and qualitative data should be gathered to determine the impact of implemented improvements on safety performance. This data can be used to track progress over time and identify areas where additional improvements may be needed.

Feedback and Continuous Improvement: Feedback from stakeholders, including employees, customers, and regulators, should be gathered and incorporated into the improvement process. This feedback helps to identify new issues and areas for further improvement, ensuring a continuous cycle of improvement. [1] [3]

IV.6: Conclusion:

The evaluation process of SMS implementation in air operations (OPS AER) is a complex but necessary undertaking for ensuring a safe and compliant aviation environment. Effective evaluation involves assessing the maturity and effectiveness of SMS components and elements across all operational areas, including flight operations, crew operations, dispatch, and training.

The resulting findings report provides a comprehensive analysis of SMS implementation and suggests actionable steps to enhance safety performance. By consistently and comprehensively evaluating SMS effectiveness, aviation stakeholders can continuously improve safety management and ensure the safety of both personnel and passengers in the air operations domain.

CHAPTER V

PROPOSITION OF A RISK-BASED SMS ASSESSMENT PROCESS FOR THE DOMAIN AIR OPERATIONS

CHAPTER V : PROPOSITION OF A RISK-BASED SMS ASSESSMENT PROCESS FOR THE DOMAIN AIR OPERATION

V.1: Introduction:

In the ever-evolving landscape of air operations, safety management remains a paramount concern. Ensuring the highest standards of safety necessitates a dynamic and proactive approach to identifying, assessing, and mitigating risks. This chapter aims to present a comprehensive proposition for a risk-based Safety Management System (SMS) assessment process tailored specifically for the domain of air operations.

Drawing on the critical evaluation of potential weaknesses and areas for improvement discussed in this chapter, this proposition leverages cutting-edge technologies and methodologies to enhance the effectiveness of SMS. The proposed framework integrates advanced tools such as predictive analytics, immersive training, and real-time monitoring to create a robust and responsive safety management environment.

The motivation behind this proposition stems from the need to address the complex and multifaceted nature of risks in air operations. Traditional safety management approaches, while foundational, often fall short in capturing the dynamic and interrelated factors that contribute to safety incidents. By adopting a risk-based assessment process, this proposition seeks to provide a more nuanced and holistic view of safety management, enabling air operators to anticipate and mitigate risks before they materialize.

This chapter outlines the key components of the proposed risk-based SMS assessment process, detailing the steps and technologies involved. It also explores the benefits of adopting such a process, emphasizing its potential to significantly enhance safety outcomes in air operations. Through this proposition, the aim is to contribute to the ongoing efforts to elevate safety standards and ensure the continued safety and reliability of air travel.

V.2: Potential weaknesses and areas to consider for improvement:

The evaluation of Safety Management System (SMS) components and elements within air operations (OPS AER) is crucial for ensuring effective safety management and regulatory compliance. However, several weaknesses can undermine the evaluation process. These include:

V.2.1:**Data Collection and Analysis**:

Incomplète or erroneous data collection is a Fundamental flaw in the evaluation process for Safety Management System (SMS) deployment. This issue might show in a variety of ways, impacting the validity and trustworthiness of the evaluation results.

Data gaps:

Data gaps arise when not all-important information is gathered, resulting in an incomplete dataset. This can be caused by inadequate record-keeping methods, a lack of access to vital information, or the failure to report occurrences and near-misses. These shortcomings may prevent evaluators from gaining a thorough grasp of SMS deployment. Critical areas may be missed, leaving potential safety issues undiscovered.

Human Error:

Human error in data gathering can take the form of improper data input, misinterpretation of information, or failure to document all pertinent details. This could be due to a lack of training, oversight, or just the difficulties of data recording. These errors have the potential to affect actual safety performance and SMS implementation levels. This can result in inaccurate conclusions and ineffective suggestions for development.

Lack of reporting:

Incidents, near-misses, or safety-related observations may go unreported for a variety of reasons, including fear of repercussions, a lack of awareness, or internal organizational cultural concerns. This underreporting creates an incomplete dataset, which can obscure underlying safety concerns. The result might lead to a false sense of security and insufficient safety precautions being put in place.

Inconsistent Data Recording:

Different departments or individuals may record data differently, producing inconsistencies. Variations in terminologies, level of detail recorded, and data entry format are all possible examples. These inconsistencies make it difficult to collect and analyze data comprehensively. Comparisons between disparate data sets might be incorrect, resulting in flawed evaluations.

Technological Limitations:

Outdated or poor data gathering systems can result in incomplete or inaccurate information. This involves restrictions in software, hardware, and data storage capacity.
These technological restrictions may limit the quantity and quality of data obtained. This can impede the ability to conduct comprehensive studies and discover trends or patterns in SMS adoption.

V.2.2:Analyze Implémentation :

The Analyze Implementation phase of Safety Management System evaluation is susceptible to several weaknesses that can hinder its effectiveness. including:

- Failure to identify root causes: If the analysis is not thorough or well-designed, the root causes of safety issues may not be accurately identified, leading to ineffective solutions or preventative measures.
- Overreliance on quantitative data: If the analysis relies solely on quantitative data without considering qualitative factors, such as human factors or organizational culture, it may overlook critical issues or opportunities for improvement.
- Narrow focus on operational issues: If the analysis focuses only on operational issues without considering other areas of SMS implementation, such as training, communication, or risk assessment, it may not provide a complete picture of safety performance.
- Lack of practical recommendations: If the analysis does not produce actionable and practical recommendations for improvement, it may fail to drive meaningful change in the organization's safety performance.

V.2.3:Action Plan Development :

Developing an action plan is a vital component of evaluating the implementation of a Safety Management System (SMS), as it outlines the necessary steps to address identified weaknesses and enhance safety performance. However, various shortcomings can hinder the effectiveness of this process. For instance, action plans often lack clear, specific, and measurable objectives, making it difficult to assess progress and accountability. Additionally, insufficient involvement of key stakeholders, including frontline employees, can result in overlooked insights and practical considerations. Inadequate resource allocation may further impede implementation, leading to delays or incomplete actions. Setting overly ambitious or unrealistic goals can cause frustration and demotivation among staff, undermining trust in the SMS. Furthermore, a lack of prioritization can spread resources too thinly across initiatives, while poor integration with existing processes may lead to resistance to change and duplication of efforts. Finally, inadequate monitoring and follow-up mechanisms make it challenging to track progress and sustain corrective actions over time, while an organizational culture resistant to change can significantly slow or halt the implementation of the action plan, perpetuating safety issues and stalling improvements in SMS performance.

V.2.4:Engagement and Communication:

Effective engagement and communication are essential for a successful Safety Management System (SMS) evaluation process, yet several weaknesses can significantly undermine their effectiveness. Lack of transparency is a major concern; when evaluators do not openly share findings or proposed actions, stakeholders may feel mistrustful and excluded, which can diminish their willingness to participate in the process. Additionally, inconsistent messaging across various channels or among different stakeholders can lead to confusion and resistance to change, as stakeholders may receive conflicting information that complicates their understanding of the SMS objectives. Furthermore, insufficient two-way communication can hinder the process; when feedback from stakeholders is not actively solicited or incorporated, the resulting action plan may be ineffective or incomplete, failing to address the real concerns of those involved. The inadequate use of technology compounds these issues; if evaluation findings are communicated through outdated methods or not utilizing effective digital tools, key stakeholders may miss crucial information or feel disconnected from the evaluation process, thereby reducing engagement and ownership. Moreover, limited cultural sensitivity in communication can lead to misunderstandings, particularly in multi-national organizations where diverse cultural contexts and language barriers exist; this oversight can alienate stakeholders and foster resistance to proposed changes. Lastly, the failure to address concerns raised by stakeholders can create feelings of frustration, resentment, and mistrust in the evaluation process, ultimately undermining the credibility of the SMS.

V.2.5:Training:

Training is a vital component in the evaluation process of Safety Management System (SMS) implementation, yet several weaknesses can undermine its effectiveness. Many training programs suffer from inadequate content that fails to address the specific needs of the organization, resulting in employees lacking the necessary knowledge and skills for effective participation. Additionally, training is often infrequent or conducted as a one-time event, which can lead to gaps in knowledge retention and an inability to stay updated on evolving safety practices. A lack of practical application in training makes it difficult for employees to translate theoretical concepts into real-world scenarios, while generic, one-size-fits-all approaches do not consider the unique roles of different employees. Engagement during training sessions can be limited, leading to poor retention of information, and organizations frequently lack mechanisms to evaluate the effectiveness of their training programs, hindering the identification of gaps and necessary improvements. Resource constraints, such as insufficient time and budget, can further limit training quality, and resistance from employees may arise due to a lack of perceived value or management support. Finally, outdated or inappropriate delivery methods that do not cater to various learning styles can diminish the overall impact of training. Addressing these weaknesses is essential for enhancing the quality and effectiveness of training programs, ultimately leading to more successful SMS implementation and improved safety performance.

V.2.6:Audit:

Audits, a vital component of evaluating Safety Management System (SMS) implementation, can be impeded by several weaknesses that undermine their efficacy. A lack of auditor independence can introduce bias into findings, resulting in skewed results that fail to accurately reflect the organization's true safety performance. Inconsistencies in audit approach across departments and locations impede the identification of organization-wide issues and the comparison of safety performance metrics, hampering the development of holistic improvements. Focusing on specific aspects of SMS implementation or merely adhering to regulatory compliance can result in missed opportunities for risk identification, hindering the organization's proactive approach to safety.

Inadequate follow-up after audits can also impede the realization of sustained improvements in safety performance, as necessary corrective actions may not be implemented or monitored effectively. Furthermore, resistance from employees or managers to the audit process, due to a perceived punitive nature of audits, can hinder the timely identification and resolution of safety issues.

V.2.7:Continuous improvement:

Continuous improvement is a cornerstone of effective SMS implementation, yet it is susceptible to various weaknesses that can impede its success. Organizations may struggle to implement a structured and systematic approach to identifying, analyzing, and addressing safety performance gaps, resulting in inconsistent or ad hoc improvement efforts. Limited resources, including time, budget, and personnel, can hinder the organization's capacity to implement meaningful changes. Furthermore, a lack of engagement and buy-in from all levels of the organization, particularly senior management, can undermine support and commitment to continuous improvement initiatives.

Moreover, inadequate feedback mechanisms and weak data analysis capabilities can prevent organizations from accurately identifying improvement opportunities and effectively measuring the impact of implemented changes. A complacent organizational culture resistant to change can also impede the adoption of continuous improvement practices, ultimately diminishing the effectiveness of the SMS. Organizations seeking to enhance the effectiveness of their continuous improvement initiatives should prioritize a systematic and data-driven approach, allocate sufficient resources, and foster a culture of engagement and change within the organization.

V.3: Proposition of a risk-based SMS assessment process for the domain AIR OPERATIONS:

While the current evaluation process of the level of implementation of Safety Management System (SMS) components and elements within the domain of air operations (OPS AER) is robust and effective, it must evolve to keep pace with rapidly advancing technologies. The existing methodologies provide a solid foundation for assessing safety management practices; however, they often fall short in integrating modern tools that can enhance predictive capabilities, real-time monitoring, and comprehensive data analysis. This chapter aims to bridge this gap by proposing enhancements to the current evaluation process, leveraging state-of-the-art technologies such as predictive analytics, immersive training, and automated data gathering. By incorporating these innovations, the proposed framework seeks to elevate the effectiveness of SMS evaluations, ensuring they remain relevant and capable of addressing the complexities of contemporary air operations. Here is a proposition of what can be added to the current evaluation process to make it better:

V.3.1:Safety Horizon Scanning:

The primary objective of Safety Horizon Scanning is to anticipate and identify emerging risks in the domain of air operations before they impact safety. This proactive approach helps organizations to stay ahead of potential threats and integrate innovative solutions into their safety management processes

Innovation Labs:

The establishment of safety innovation labs aims to proactively manage risks, integrate new technologies, and continuously enhance safety practices while fostering collaboration and ensuring compliance with regulatory requirements. To create these labs, organizations should first define a clear vision and specific objectives focused on improving safety outcomes, such as reducing incidents and adopting new technologies. Securing adequate resources, including funding and advanced facilities equipped with research tools and simulation systems, is essential. A multidisciplinary team comprising experts from various fields should be assembled to encourage collaboration and innovation, supported by ongoing training. Developing a structured process for research, innovation, and implementation will facilitate the continuous monitoring of trends and the testing of new solutions. Engaging both internal and external stakeholders is crucial for sharing insights and progress. Finally, organizations should establish key performance indicators (KPIs) to evaluate the lab's effectiveness and regularly report on its impact. For example, an aviation safety innovation lab might aim to reduce incidents by 20% over five years while integrating three new technologies annually, supported by a dedicated budget and a team of experts. By following these steps, organizations can effectively create safety innovation labs that enhance safety management and drive continuous improvement.

Crowdsourced Risk Intelligence:

Crowdsourced risk intelligence aims to gather valuable risk insights from a diverse group of stakeholders, such as pilots, crew members, and industry experts. This approach leverages the collective knowledge and experience of a broad community to identify and assess risks more effectively.

To implement crowdsourced risk intelligence effectively, organizations should follow several key steps. First, they need to develop a crowdsourcing platform, designing an online platform or mobile app that allows stakeholders to easily submit risk insights, complete with user-friendly features such as risk reporting forms, discussion forums, and data analytics tools, while also ensuring options for anonymity to promote open reporting. Next, organizations should engage and educate stakeholders through awareness campaigns that highlight the importance of their contributions and provide training sessions on identifying and reporting risks. Facilitating easy reporting is crucial, so organizations should create simplified forms, ensure mobile access, and offer multilingual support to accommodate diverse stakeholders. To encourage participation, organizations can offer incentives like recognition and establish a feedback loop to inform contributors about the impact of their reports. Following data collection, organizations must analyze and validate the submitted information, using data analytics tools to identify trends and having safety experts verify the accuracy of reports. The insights gathered should then be integrated into the Safety Management System (SMS), assessing identified risks and developing appropriate mitigation strategies while continuously monitoring their effectiveness. Finally, organizations should communicate results through regular reports and dashboards that share findings with stakeholders and hold meetings to discuss insights and progress. By following these steps, organizations can harness the collective intelligence of their stakeholders to enhance risk management and improve safety outcomes.

Example:

Airline Example:

Platform Development: An airline develops a mobile app where pilots, crew members, and maintenance staff can report safety concerns and potential risks.

Stakeholder Engagement: The airline launches an awareness campaign and provides training sessions on how to use the app and the importance of risk reporting.

Reporting Features: The app includes simplified reporting forms, options for anonymity, and multilingual support.

Incentives: The airline offers rewards for the most valuable risk reports and recognizes contributors in internal newsletters.

Data Analysis: A team of safety experts analyzes the submitted reports, identifies trends, and validates the data.

Integration with SMS: The airline integrates the crowdsourced insights into its SMS, assessing risks and developing mitigation strategies.

Communication: The airline shares regular updates with all employees on the risks identified and the actions taken, reinforcing the value of their contributions.

By implementing crowdsourced risk intelligence, organizations can tap into a wealth of knowledge and experience from a broad range of stakeholders, leading to more comprehensive risk identification and improved safety management.

Predictive Analytics:

Predictive analytics and artificial intelligence (AI) are revolutionizing safety management by analyzing historical data to identify patterns and anticipate future risks before they occur. To effectively implement this approach, organizations should first define clear objectives and scope, such as reducing incident rates, identifying emerging risks, and improving operational efficiency. This involves gathering and preparing comprehensive data from various sources, including flight data recorders, maintenance logs, and incident reports, and ensuring the data is cleaned and standardized. Developing predictive models using advanced AI algorithms, such as regression analysis and neural networks, is crucial for accurately forecasting risks. Once validated, these models should be integrated into user-friendly software tools that connect seamlessly with the organization's existing IT infrastructure, allowing safety managers to visualize results and make informed decisions. Insights derived from AI-driven predictive models can then be used to assess potential future risks, develop targeted mitigation strategies, and continuously monitor model performance. Fostering a data-driven culture through training and stakeholder engagement is essential for maximizing the benefits of AI in predictive analytics, while regular evaluation and continuous improvement efforts will enhance the overall effectiveness of safety management practices.

Example:

An airline seeking to enhance safety and operational efficiency through predictive analytics sets clear objectives, such as reducing incident rates by 15% and improving on-time performance. The airline collects and integrates historical flight data, maintenance records, and incident reports from the past five years into a centralized database, ensuring data consistency. Machine learning algorithms, including random forests and neural networks, are selected to develop predictive models, with features like flight duration, weather conditions, and maintenance intervals identified as key variables. The models are validated using a testing dataset, achieving high accuracy in forecasting maintenance needs and potential delays. User-friendly predictive analytics tools are then deployed, featuring an intuitive dashboard that allows safety managers to view risk predictions and trends. Insights from the AI-driven models are seamlessly integrated into the airline's Safety Management System (SMS), enabling the assessment of predicted risks and the implementation of preventive measures, such as scheduling additional maintenance checks based on the forecasted risk of component failure. To foster a data-driven culture, the airline provides training to staff on using the tools and interpreting results, while regular meetings are held to discuss insights and gather feedback from stakeholders. Continuous monitoring of model performance and refinement of the algorithms with new data ensure ongoing improvement in the accuracy and effectiveness of the predictive analytics system, ultimately enhancing safety and operational efficiency across the organization.

V.3.2:Data Collection and Analysis:

Automated Data Gathering :

Automated data gathering in air operations focuses on collecting real-time data from aircraft systems, ground operations, and crew activities to improve safety, efficiency, and decision-making processes. To implement this approach, organizations should first identify their objectives, such as enhancing predictive maintenance and operational efficiency, while determining key data sources, including aircraft systems and crew activities. Next, they need to select appropriate sensors and IoT devices to measure relevant parameters like engine performance and crew health, ensuring these devices can transmit data wirelessly for real-time analysis. Following installation, the sensors must be integrated with existing systems, and a robust data collection infrastructure should be developed to aggregate and securely transmit the data, utilizing cloud platforms for storage and processing. Real-time monitoring tools and analytics should be implemented to track key performance indicators and detect anomalies, while strong data security and privacy measures must be established to protect sensitive information. The insights gained from this automated data gathering should be integrated into the organization’s Safety Management System (SMS) to enhance risk assessment and decision-making. Finally, training personnel on the use of these technologies and fostering a data-driven culture will maximize the benefits of automated data gathering, leading to improved safety and operational outcomes.

Example:

An airline issues smartwatches to its flight attendants. The smartwatches monitor heart rate, sleep quality, and activity levels. Before each flight, data is reviewed to ensure that crew members are well-rested and fit for duty. If a crew member shows signs of excessive fatigue, they are assigned to a less demanding role or given additional rest time. This proactive approach reduces the risk of fatigue-related errors and enhances passenger safety.

Big data analytics:

Big data analytics is designed to process and analyze vast amounts of data to identify patterns and trends, providing valuable insights that can highlight potential risks and enhance decision-making in air operations. To implement big data analytics effectively, organizations should first define their objectives and scope, focusing on goals such as improving safety and operational efficiency while determining the types of data to analyze, including flight data, maintenance records, and passenger feedback. Next, data should be collected from various sources, integrated into a centralized data warehouse, and cleaned for analysis. Selecting appropriate tools and technologies is crucial, with options like Apache Hadoop and cloud-based solutions for data storage and processing. Developing a robust data analytics infrastructure involves setting up automated data pipelines for efficient extraction and processing, as well as implementing real-time and batch processing capabilities. Organizations should then apply advanced analytics and machine learning algorithms to train models that can predict risks and identify patterns. Creating dashboards and visualization tools will help present the data and analytics results in an accessible manner. Integrating these insights into the organization's Safety Management System (SMS) will enhance risk assessment and incident reporting, while fostering a data-driven culture through training and collaboration among departments will maximize the benefits of big data analytics. Regular evaluation and continuous improvement of the analytics process will ensure that organizations can adapt and respond effectively to emerging challenges and opportunities in aviation operations.

Example:

An airline seeking to enhance safety and improve operational efficiency through big data analytics collects data from various sources, including flight data recorders, maintenance logs, weather stations, and passenger surveys, which is then integrated into a centralized data lake, cleaned, and standardized for analysis. The airline utilizes Apache Spark for real-time and batch data processing, AWS Big Data for storage and analysis, and Tableau for developing interactive dashboards that visualize insights. Advanced machine learning models are trained using historical data to predict potential risks, such as engine failures or weather-related delays, and the insights are seamlessly integrated into the airline's Safety Management System (SMS) to enhance risk assessment and incident reporting processes. To foster a data-driven culture, training programs are conducted to educate staff on using analytics tools and interpreting results, while regular meetings are held to discuss insights and develop data-driven strategies aimed at optimizing operations and mitigating risks.

AI and Machine Learning:

The implementation of AI and machine learning in air operations aims to enhance overall safety by leveraging historical data to predict potential safety issues, enabling proactive risk management. This process begins with collecting and preparing data from various sources, including flight data recorders, maintenance logs, weather data, and sensor information, ensuring it is clean, standardized, and ready for analysis. Feature engineering is then conducted to identify relevant variables and create new features that could influence safety outcomes. Appropriate machine learning algorithms are selected based on the data type and prediction goals, such as regression models for forecasting continuous outcomes like engine failure likelihood, classification models for predicting categorical events like flight delays, and anomaly detection for identifying unusual patterns that may indicate potential risks. The models are then trained on a portion of the data, validated using the remaining data to assess performance, and deployed into the organization's existing Safety Management System (SMS) and operational workflows for real-time monitoring and prediction of safety issues. Continuous monitoring of model performance and regular updates with new data ensure the models maintain accuracy and adapt to changing conditions, while a feedback loop allows insights from the predictions to refine and improve the models over time.

Example:

An airline aims to enhance safety and operational efficiency by implementing AI and machine learning to predict potential safety issues, such as unexpected delays or incidents during flights. The process begins with data collection from various sources, including flight data recorders, maintenance logs, weather data, Air Traffic Control communications, crew reports, and aircraft sensors. This data is then cleaned, standardized, and integrated into a unified dataset. Feature engineering follows, where relevant features influencing safety outcomes, such as engine performance metrics and weather conditions, are identified and new features are created. Appropriate machine learning algorithms, including classification models for predicting delays and anomaly detection for identifying unusual patterns, are selected. The data is split into training and testing sets to train and validate the models, ensuring high accuracy and reliability. Once trained, the models are integrated into the airline’s operational systems, enabling real-time predictions and automated alerts for potential safety risks. Continuous monitoring and model updates with new data ensure ongoing accuracy, while a feedback loop allows for the refinement of models based on prediction outcomes. By leveraging AI and machine learning, the airline can proactively manage risks, enhancing safety and operational performance significantly.

V.3.3:Advanced Monitoring and Evaluation:

To implement advanced monitoring and evaluation techniques for Safety Management System (SMS) performance, organizations should establish real-time performance dashboards that enhance visibility into safety performance indicators (SPIs) and the effectiveness of risk controls. This involves identifying key SPIs relevant to operations, such as incident rates and maintenance issues, and integrating data from various sources into a centralized database. Developing interactive dashboards using tools like Tableau or Power BI will allow for real-time display of SPIs, highlighting key metrics and trends. Additionally, ensuring real-time data feeds from IoT devices and providing access to relevant personnel, such as safety and operations managers, will enable prompt monitoring and response to safety performance issues.

V.3.4:Communication and Reporting:

Digital Reporting Tools:

To implement digital reporting tools, airlines should first gather requirements from different user groups, including flight crew, cabin crew, and ground staff, to ensure the reporting tool meets their specific needs. This can be achieved through stakeholder meetings to identify essential features such as user-friendly interfaces, offline reporting capabilities, integration with existing safety management systems, and real-time data submission.

Next, airlines should select or develop a digital platform tailored to their requirements. This involves conducting market research to explore existing digital reporting tools available, considering options such as third-party solutions or custom-developed apps. Once a suitable platform is selected, it should be customized to include airline-specific reporting forms, incident categories, and workflow integration, ensuring a seamless and efficient reporting process for all users.

Example: An airline selects a third-party safety reporting app known for its robust features and customizes it to include specific fields for reporting engine malfunctions, cabin incidents, and ground operation issues.

Automated Notifications:

By establishing automated notification systems, airlines can proactively identify and respond to emerging risks or incidents in real-time. These systems are designed to continuously monitor various data sources, such as flight data recorders, maintenance logs, and safety reports, to detect potential issues or anomalies that require immediate attention.

When a critical incident or risk is identified, the automated system triggers alerts that are instantly sent to relevant personnel, such as flight crews, maintenance teams, and safety managers. These alerts can be delivered through multiple channels, including SMS, email, and push notifications, ensuring that the right people are informed promptly, regardless of their location or device.

The ability to receive real-time alerts enables airlines to take immediate action to mitigate risks and prevent incidents from escalating. For example, if the system detects a critical engine fault, it can trigger an alert to the maintenance crew, allowing them to prepare for the aircraft's arrival and initiate necessary repairs or inspections. This proactive approach helps maintain the highest levels of safety and operational efficiency.

Moreover, automated notification systems can be configured with escalation procedures that ensure incidents are addressed in a timely manner. If an alert is not acknowledged or resolved within a specified timeframe, the system can automatically escalate the issue to higher-level personnel or trigger additional notifications to ensure that appropriate action is taken.

By continuously monitoring the effectiveness of the notification system and gathering feedback from users, airlines can make data-driven decisions to improve the system's performance. Key performance metrics, such as response times, resolution times, and incident outcomes, can be tracked to identify areas for improvement and optimize the system's configuration.

Regular updates to the notification rules and system configurations allow airlines to adapt to new risks and incorporate user feedback, ensuring that the system remains effective and relevant over time. This continuous improvement process is crucial for maintaining a strong safety culture and adapting to the evolving challenges faced by the aviation industry.

In summary, implementing automated notification systems enables airlines to enhance their safety management practices by providing real-time alerts, improving communication and coordination, enabling proactive risk management, and continuously improving the system based on performance data and user feedback. By embracing this technology, airlines can significantly enhance their ability to respond to emerging risks and incidents, ultimately leading to improved safety and operational efficiency.

V.3.5:Training and Simulation:

Virtual Reality (VR) and Augmented Reality (AR):

To implement Virtual Reality (VR) and Augmented Reality (AR) for training purposes, the first step is to clearly define the training objectives. This involves identifying specific training goals and scenarios that would benefit from the enhanced realism and interactivity provided by these technologies.

Implementation Steps:

- **Needs Assessment:** Conduct an assessment to pinpoint which areas of training would gain the most from increased realism and interactivity. Focus on critical training areas such as emergency scenarios, safety procedures, and infrequent yet vital situations.
- **Training Scenarios:** Develop detailed training scenarios that can be simulated using VR and AR technologies. Examples include emergency evacuations, in-flight medical emergencies, fire drills, and equipment handling practices.

This structured approach ensures that the training delivered through VR and AR is relevant, engaging, and effective in preparing crew members for real-life challenges.

Example:

To select the appropriate VR and AR technologies for training, airlines should choose hardware like VR headsets (e.g., Oculus Rift, HTC Vive) and AR devices (e.g., Microsoft HoloLens) based on factors such as comfort, usability, and technical specifications, while also ensuring compatibility with existing training systems. Software platforms that offer realistic simulations and customizable training modules, such as Unity, Unreal Engine, or specialized aviation training software, should be evaluated and selected to meet the specific training requirements, which may include key areas like emergency evacuation procedures, handling in-flight fires, and responding to medical emergencies. This structured approach to hardware and software selection, while considering compatibility with current infrastructure, enables airlines to implement VR and AR technologies that effectively enhance training experiences and outcomes.

Online Learning Platforms:

Online Learning Platforms can provide a flexible and effective solution for training and educating staff on SMS implementation. By using e-learning modules and virtual training sessions, organizations can ensure that employees can access training materials at their convenience, without having to travel or take time off from work.

E-learning modules can include interactive quizzes, videos, and other multimedia content to keep staff engaged and help them retain information. Virtual training sessions can allow employees to participate in live demonstrations, ask questions, and discuss safety practices with trainers or peers.

Online Learning Platforms can be tailored to meet the specific needs of different departments or job roles, ensuring that all employees receive relevant and targeted training. These platforms can also track employee progress and provide managers with insights into which areas may require additional attention.

By leveraging technology to deliver training and education, organizations can promote continuous learning and improvement of safety practices, fostering a safety culture that prioritizes proactive risk management and incident prevention.

V.3.6:Documentation and Compliance:

Digital Document Management:

Deploy digital document management systems to guarantee that all SMS documentation, policies, and procedures are easily accessible and consistently updated.

Implementing a digital document management system (DMS) enables airlines to effectively manage their Safety Management System (SMS) documentation, ensuring that all policies and procedures are easily accessible, consistently updated, and securely handled. The process begins with assessing requirements through stakeholder consultations and needs assessments to identify key features needed for effective document management. Following this, a suitable DMS platform, such as SharePoint or Documentum, is selected based on its capabilities, and a pilot test is conducted to gather feedback. Existing documents are then digitized using OCR technology, ensuring they are standardized and searchable. The chosen DMS platform is deployed and configured to meet organizational needs, followed by comprehensive training programs for staff to ensure effective usage. Continuous monitoring, usage analytics, regular audits, and user feedback are essential for maintaining the system's effectiveness and compliance with regulatory standards. The benefits of a DMS include enhanced accessibility, improved accuracy, increased security, efficient document handling, regulatory compliance, and cost savings, ultimately leading to better safety management and operational efficiency for airlines.

Blockchain for Compliance:

Implementing blockchain technology in air operations can significantly enhance compliance management by creating immutable records that verify adherence to regulatory standards, thus improving the efficiency and transparency of audits. The process begins with educating stakeholders about blockchain and its applications in compliance, followed by a thorough review of relevant regulatory requirements to determine what needs to be recorded. A suitable blockchain platform is then selected based on security, scalability, and integration capabilities, and pilot testing is conducted to evaluate its effectiveness. Smart contracts are developed to automate the recording and verification of compliance data, which are integrated into existing compliance processes. After deploying the blockchain system and migrating historical compliance records, staff are trained on its usage. Continuous monitoring and regular audits ensure the system's effectiveness and accuracy. The benefits of this approach include immutable records that enhance data integrity, increased transparency for auditors, automated processes that reduce human error, robust security measures, real-time updates on compliance status, and a comprehensive audit trail that simplifies the auditing process, ultimately leading to a more efficient compliance management system for airlines.

V.3.7:Holistic Audit and Compliance:

Implementing a holistic audit and compliance approach involves integrating immersive technologies, creating cohesive compliance ecosystems, and establishing continuous feedback loops for ongoing improvements. This strategy begins with enhancing audit processes through immersive experiences, such as using augmented reality (AR) to visualize compliance data. Auditors identify specific use cases for AR, select suitable tools, develop applications, and receive training to effectively utilize these technologies. Next, organizations build integrated compliance ecosystems by mapping regulatory requirements, centralizing compliance data, and automating workflows to streamline processes. Finally, continuous feedback loops are established through real-time monitoring and automated reporting, allowing for immediate updates based on audit findings. The benefits of this approach include enhanced insights, streamlined processes, proactive management of compliance issues, and improved efficiency, ultimately leading to better compliance with regulatory standards and continuous operational improvements.

V.3.8:Feedback and Continuous Improvement:

1. **Feedback Systems:**

Setting up digital platforms for collecting feedback from employees and stakeholders on safety procedures and Safety Management System (SMS) effectiveness involves creating an organized and systematic approach to gather insights and opinions. This can be achieved through the implementation of employee feedback software, which provides tools for collecting, analyzing, and acting on feedback efficiently.

Key Components of Feedback Systems:

Digital Platforms: Utilize employee feedback tools that allow for anonymous submissions, ensuring that employees feel safe to express their thoughts candidly. These platforms can take various forms, such as survey tools, pulse surveys, and digital suggestion boxes, enabling real-time feedback collection.

Types of Feedback: Collect feedback through various methods, including:

Surveys: Structured questionnaires that assess employee opinions on safety protocols and SMS effectiveness.

Pulse Surveys: Short, frequent surveys that gauge employee sentiment on specific issues.

360-Degree Feedback: Comprehensive feedback from multiple sources, providing a well-rounded perspective on safety practices.

Data Analysis: Implement tools that analyze the feedback collected to identify trends, areas for improvement, and overall employee sentiment regarding safety procedures. Features like sentiment analysis and reporting can help in understanding the feedback contextually.

Actionable Insights: Use the data gathered to inform decision-making and improve safety practices. The feedback should lead to actionable recommendations that can enhance the effectiveness of safety procedures and SMS.

Continuous Improvement: Establish a feedback loop where insights from employees are regularly reviewed and integrated into safety management strategies. This ongoing process fosters a culture of transparency and continuous improvement.

By leveraging digital feedback systems, organizations can enhance communication around safety protocols, ensure stakeholder engagement, and ultimately improve the effectiveness of their SMS. This approach not only promotes a safer workplace but also empowers employees by valuing their input and fostering a collaborative environment.

2. **Continuous Improvement Tools:**

Utilizing continuous improvement tools, such as Six Sigma software, to analyze feedback and performance data is a strategic approach aimed at enhancing safety management within organizations. Six Sigma is a data-driven methodology focused on reducing defects and improving processes by systematically identifying and eliminating root causes of problems.

Key Aspects of Using Six Sigma for Safety Management:

DMAIC Framework: The Six Sigma process follows the DMAIC model—Define, Measure, Analyze, Improve, and Control. This structured approach helps organizations clearly define safety issues, measure current performance, analyze data to identify root causes of incidents, implement improvements, and control processes to sustain these enhancements.

Data Analysis: By leveraging Six Sigma software, organizations can collect and analyze performance data related to safety incidents. This involves gathering quantitative data on accident rates, near misses, and compliance with safety protocols. The software can help visualize trends and patterns, making it easier to identify areas needing improvement.

Root Cause Analysis: The software facilitates thorough root cause analysis, allowing teams to investigate underlying issues contributing to safety incidents. Techniques such as fishbone diagrams or Pareto charts can be used to systematically identify factors leading to accidents, which can then be addressed through targeted interventions.

Performance Metrics: Continuous improvement tools enable organizations to establish and track key performance indicators (KPIs) related to safety. By monitoring these metrics over time, organizations can assess the effectiveness of safety initiatives and make data-informed decisions to enhance safety management practices.

Feedback Integration: Continuous improvement tools can integrate feedback from employees and stakeholders regarding safety procedures and the effectiveness of the Safety Management System (SMS). This feedback is crucial for identifying gaps in safety practices and ensuring that improvements are aligned with employee experiences and concerns.

Sustaining Improvements: The Control phase of the DMAIC process ensures that improvements are maintained over time. Six Sigma software can facilitate ongoing monitoring and reporting, helping organizations to adapt and refine their safety practices continuously based on real-time data and feedback.

By employing Six Sigma software for continuous improvement in safety management, organizations can create a proactive safety culture that not only reduces incidents but also fosters an environment of ongoing enhancement and employee engagement. This approach ultimately leads to a safer workplace and improved operational efficiency.

V.4: Conclusion:

In the rapidly evolving domain of air operations, maintaining the highest standards of safety is both a priority and a challenge. This chapter has highlighted the potential weaknesses of traditional Safety Management Systems (SMS) and introduced a comprehensive, risk-based SMS assessment process designed to address these challenges effectively.

The proposed framework incorporates innovative tools and methodologies such as predictive analytics, immersive training technologies, real-time data monitoring, and blockchain for compliance. By integrating these advanced techniques, the framework aims to create a more adaptive and resilient safety management environment. The risk-based approach allows for a nuanced understanding of potential hazards, facilitating proactive identification and mitigation of risks before they manifest as incidents.

Implementing safety horizon scanning, crowdsourced risk intelligence, and automated data gathering ensures that air operations can continuously monitor and evaluate their safety performance in real-time. These strategies not only enhance the effectiveness of risk controls but also foster a culture of continuous improvement and responsiveness to emerging threats.

The benefits of adopting this risk-based SMS assessment process are manifold. It enhances the ability to anticipate and manage risks, improves compliance with regulatory standards, and ultimately contributes to safer and more reliable air operations. By focusing on a holistic and proactive approach to safety management, this proposition supports the aviation industry's commitment to achieving the highest levels of safety and operational excellence.

In conclusion, the risk-based SMS assessment process presented in this chapter represents a significant advancement in safety management for air operations. It addresses the inherent complexities of the aviation environment and provides a robust framework for managing risks effectively. As air operations continue to evolve, adopting such innovative approaches will be crucial in ensuring the continued safety and success of the industry.

General Conclusion

General Conclusion

The successful implementation of a Safety Management System (SMS) is critical for ensuring safe and efficient air operations, particularly in the complex and challenging environment of Algeria's airspace. This research has examined the evaluation process of SMS components and elements within the domain of air operations (OPS AER), highlighting the importance of safety reporting systems, database management, and the monitoring of safety performance indicators.

Through this study, it has become evident that a robust, risk-based evaluation process is essential for identifying gaps and enhancing the overall safety of operations. The incorporation of artificial intelligence (AI) and other advanced technologies offers significant potential for improving the accuracy and effectiveness of SMS evaluations. AI-driven tools allow for real-time analysis of safety data, better prediction of risks, and more proactive risk mitigation strategies.

The findings suggest that while current SMS practices in Algeria align with regulatory standards, there is room for improvement, particularly in the use of modern technology to streamline evaluations and safety monitoring. By adopting a risk-based approach and integrating AI into the SMS framework, air operations can achieve higher levels of safety, better compliance, and a more proactive safety culture.

In conclusion, this research underscores the importance of continuous improvement in SMS implementation, driven by technological innovation. Such advancements will be vital for maintaining aviation safety in an ever-evolving operational landscape, ensuring the safety of aircraft, crew, and passengers in the years to come.

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