UPES
UNIVERSITY OF TOMORROW
Centre for Continuing Education

Aviation Safety and Security Management

Unit 1

Introduction to Aviation Safety and Security Management

Learning Objectives

By the end of this unit, you will be able to:

- Describe safety management
- Explain safety statistics
- Discuss economic benefits of aviation safety and traffic growth
- Know security management
- Explain global aviation and security plan

Introduction

Safety and security is one of the prime concerns of the stakeholders to aviation. However, safety and security are two distinct features that often overlap each other.

ICAO, IATA and Civil Aviation Authorities (CAAs) such as Director General of Civil Aviation (DGCA) and Bureau of Civil Aviation Security (BCAS) in India, provide standards, guidelines/practices, and strategic directions to enhance safety and security in Aviation.

ICAO propagates Standards and Recommended Practices (SARPs) to facilitate the ease of regulations in aviation safety and security globally. At present, ICAO manages over 12,000 SARPs across the 19 Annexes and Procedures for Air Navigation Services (PANS).

In addition to these ICAO also lays down the guidelines for the SARPs through documents. ICAO is the crux to establish cooperation in all fields of civil aviation among its 193 Member States.

IATA which represents the airline industry has published manuals on safety and security concerning the aviation industry. Along with this, it is also involved in providing training courses and also takes care of safety/ security audits. FAA, EASA, and CAA are some of the most noted regulators, whose publications, advisory circulars, and guidelines are adopted by various States.

In India, DGCA issues advisory circulars, lays down guidelines, develops the State Safety Program (SSP), and approves/monitors the implementation of SMS of aviation organizations. BCAS in India is the regulator for civil aviation security. It publishes guidelines, processes, and procedures for the implementation of Annex 17 / Doc 8973.

The National Civil Aviation Security Programme (NCASP), implemented by BCAS:

- monitors the implementation of regulations, standards, measures, practices, and procedures by airports and airlines
- inspects respective facilities to ensure compliance
- conducts training programs & audits
- certifies screeners (hold baggage screening) and issues Aerodrome Entry Permits (AEP).

With remarkable and relentless aviation traffic growth, more aircraft, busier airports, more airline personnel (cockpit crew and cabin crew) & aircraft maintenance teams, etc., are anticipated. Also, effective & efficient oversight, monitoring, and ensuring thorough implementation of SOPs are required.

This unit focuses on the management system for the States and Service Providers, for sustained safety enhancement and improved safety performance. The safety measures related to the transportation of dangerous goods, Aerodrome emergency planning, and ARFF services (for preparedness and reducing the impact due to accidents), and safety audits by ICAO, IATA is also covered in this unit.

The course content on the security management aspect is prepared based on ICAO SARPs, ICAO manuals, DGCA circulars, IATA / ICAO reports & publications.

Some of the contents are 'as described in these documents so that the intent of the guidelines is maintained but the description is condensed for initiation into the safety and security management aspects. Some practices as it happens in the industry have been included to explain the context for better understanding.

Safety Management

The best way to manage safety is by improving safety performance. This can be done by implementing State Safety Programme (SSP), which systematically addresses the safety risks. For the SSP implementation, ICAO supports the States through deliverables with specific timelines (from the year 2016 to 2022), for each deliverable. The deliverables are:

1. Issuance of SARPs including amendment 1 to Annex 19.
2. Providing Guidance and Training such as Safety Management Training Programs / Courses, SMS manual Doc 9859 (4th Edition), SMS workshops, online courses on Safety Management, SSP foundation tool, SMS implementation tool, the launch of SMS website, Symposium & Seminars.
3. Universal Safety Oversight Audit Programme (USOAP), Continuous Monitoring Approach (CMA), Revision to Safety Oversight Manual (Doc 9734), SSP implementation assessment on selected States, and SSP Protocol Questions (PQs) for States.
4. Global Aviation Safety Plan (GASP) – GASP tries to establish a continuous safety strategic plan. The

purpose is to enable the continuous development of the aviation system. ICAO is responsible for laying down the broad objectives of the GASP. ICAO further proposes timelines for the implementation of the objectives so established. Another publication, Global Air Navigation Plan (GANP) by ICAO ensures continuous safety improvement and air navigation modernization to advance together.

Documents and annexures from ICAO such as Doc 9859- SM manual, Safety Oversight Manual (Doc 9734), and sector-specific safety management guidance material in Annex 1, 6, 8, 11, 13, and 14 (refer to the Annex for the title of these Annex and also, other manuals) are the guidance/ reference materials. In addition to these, ICAO also promotes safety through videos and promotional flyers.

One of the biggest challenges in the aviation business is to develop and implement an effective safety management system. Employing ICAO SARPs as a minimum, States shall ensure the highest level of safety in the Aviation System. Director General of Civil Aviation (DGCA) is the regulatory body in India, it also governs the safety aspects of civil aviation in India. DGCA's vision "Endeavour to promote safe and efficient Air Transportation through regulation and proactive safety oversight system" fosters ICAO's objective.

Safety Statistics

As per the annual review report of IATA, — "Every accident, of course, is a tragedy. And that makes the aviation industry all the more determined to improve on its safety record each successive year". As per the IATA report, the safety statistics for a five-year period 2013–2017 were 8.8 fatal accidents on average and approximately 234 fatalities. The year 2017 recorded very low fatal accidents with only 6 and 19 passenger & crew fatalities. If we look at the figures for the year 2018, there were 11 deadly accidents, which resulted in 523 fatalities comprising both the passengers as well as the members of the crew.

While comparing the safety statistics, it is ideal to compare in terms of all-accident instead of the actual number of accidents or fatalities since the traffic increase is to be considered. Thus, the all-accident rate (measured in accidents per 1 million flights) in 2018 was 1.35, the equivalent of

1 accident for every 740,000 flights. This was less than the over all-accident rate of 1.79 in the 2013-2017 period. But the accident rate in the year 2017 was recorded as low at 1.11.

Aircraft crashes in Oct 2018 and March 2019 involving Boeing 737MAX shuddered the entire aviation industry, as these two crashes happened within a span of four months under similar circumstances and of the same aircraft model. This resulted in the grounding of the entire fleet of this aircraft model globally and all deliveries of this aircraft model have been abrogated.

ICAO identified High-Risk Categories (HRCs) of occurrences, runway safety-related events such as abnormal runway contact, runway excursion and/or incursion, loss of control on the ground, ground collision, collision with obstacles, and undershoot/overshoot). The loss of Control-In Flight (LOC-I) and Controlled Flight In to Terrain (CFIT), (Mid-air collision included in the year 2019) fall under this category. In the year 2018, these HRCs contributed to 73% of fatal accidents, 96% of fatalities, 54% of accidents, and 80% of accidents wherein the aircraft was substantially damaged.

Safety performance targets can be achieved with contributions from airlines to airplane manufacturers, airports, and airplane maintenance organizations/teams. Civil aviation regulators play a vital role in the oversight function for safety implementation. The investigation report of the aircraft accident mentioned above (Boeing 737 MAX), points out deficiencies in the aircraft control system design and certification, airlines maintenance work, failure to provide information on the flight control system to pilots, etc. Cooperation and communication among stakeholders enhance safety performance. ICAO ensures continuous collaboration through established regional bodies/organizations, such as Regional Aviation Safety Groups (RASGs), Regional Safety Oversight Organizations (RSOOs), and Regional Accident and Incident Investigation Organizations (RAIOs), to promote and develop capacity building and the implementation support necessary to address emerging safety issues.

Annex 13 (Aircraft Accident and Incident

Investigation) requires States to investigate accidents and incidents to prevent such incidents. The safety investigation process establishes a set of Safety Recommendations (SRs), which are addressed to States or to ICAO if the investigators want to implement any changes to ICAO documents. In the Year 2018, ICAO received six SRs from six States.

Some of the common causes of accidents/ incidents are mentioned below:

- **Human factors** such as fatigue, inadequate coordination, mis or poor communications, use of non-standard ATC phraseology, non-familiarization of airport layout resulting in runway incursion, and inadequate training/re-training to staff working at the airside of the airport.
- **Environmental factors** such as poor visibility, wind shear, heavy rain, snow, crosswind, deficiencies in weather reporting, bird strikes, technical issues related to aircraft performance, etc.
- **Ground movement related** such as the collision of a vehicle with aircraft, foreign object debris (damage), aircraft refueling operations related.
- **Airport infrastructure related** such as failure of runway/taxiway lights, poor surface friction of runway, inadequate airfield signs, airfield layout with hotspots, inadequate clearances, obscured airfield pavement marking, and non-compliance to SARPs in design/operations/maintenance.
- **Obstacles** in or around the airport resulting in operational restrictions or impact.

Economic Benefits of Aviation Safety and Traffic Growth

In the year 2018, globally 4.3 billion passengers used the air mode of transport and 58 million tons of air freight were handled during the year. There were 38 million scheduled commercial flights and airlines covered 48,500 routes, 54 billion KM and 85 million hours were flown. During this year,

the economic impact was US$ 2.7 trillion. Aviation plays a significant role in achieving economic prosperity.

As per the latest long-term traffic forecasts given by ICAO, in the next twenty years, the air passenger traffic and air freight traffic will get almost get double. Hence the economic benefits will also grow from the present numbers in terms of employment, etc. Air traffic depends on many factors but the most important are competitive airfares, relative price to other modes of transport like road/rail, and income level of the people.

Aviation is the safest and most efficient mode of transport for long-range travel. However, any safety issue is most likely to affect travelers' choices of destinations, especially after the occurrence of an unfortunate event.

As per ICAO, the potential impact of safety on traffic demand can be estimated using the econometric model, which uses an Effective Implementation (EI) score measured by the ICAO Universal Safety Oversight Audit Program Continuous Monitoring Approach as a proxy to each State's safety performance. With all other factors affecting traffic being constant, this hypothetical analysis suggests that a 10 percent improvement of the EI of a State's safety oversight system might generate, on average, an additional 1.8 percent of aircraft departures from the State concerned.

The UN Secretary General's High-level Advisory Group on Sustainable Transport advocates that all stakeholders must genuinely attempt to transform the transport system in terms of individual travel and freight into one that is "safe, affordable, accessible, efficient, and resilient while minimizing carbon and other emissions and environmental impacts".

It is a fact that it is highly impossible to achieve a zero accident/incident scenario. However, efforts

need to be made to achieve as much as possible. It is practical to accept a certain level of risks involved. Determining the acceptable level of safety is generally the responsibility of the State. ICAO tries to adopt a predictive approach that could eliminate risks before they cause accidents.

Security Management

The aviation industry is highly vulnerable to attacks and targets. It is vulnerable to repercussions whether human, psychological or even economic. A single attack leads to a high number of causalities.

Aviation security is per se the responsibility of the State as well as the stakeholders. The focus should be on providing security and safety to the passengers as well as the crew members. At the same time, efforts should be made to minimize disruption, ensure facilitation to passengers and achieve desired economic benefits. The security measures vary from airport to airport and certainly between States as the threat perception and topical security breaches/incidents determine the enforcement of security measures, and such information is available with the States. The airlines and airports have the operational capability to ensure the proper implementation of all measures that contribute to the attainment of security with minimal disruption.

ICAO SARPs Annex 17 specifies the outcome-based requirement without specifying the technology to be adopted. Some States implement exceed than SARPs based on the reasons mentioned above. Some States that may not have implemented SARPs fully and 40th ICAO Assembly in the year 2019 should ensure to meet global standards in their National Civil Aviation Security Programs.

Global Aviation and Security Plan

In November 2017, a majority of national governments agreed to GASeP under the auspice of ICAO.

This was the first time that many countries

GASeP identifies five priorities

prepared a framework for aligning national aviation security efforts so as to cater to security issues. In fact, GASeP has initiated a movement to ensure improvements in the field of security in the aviation industry.

There is, moreover, an urgent need for developed countries to provide more comprehensive assistance to their developing counterparts to ensure that the baseline security measures are applied. Provided the principles of GASeP continue to resonate with stakeholders, the industry will move ahead of the threat trajectory.

However, as per IATA, information sharing among States and between States and the air transport industry is a big challenge. But it has been realized that things have improved to an extent since the shooting down of MH 17. This incident has exposed gaps in the sharing of threat information, and therefore it is now imperative to strictly comply with information sharing/exchange as per Annex 17.

Unlike safety statistics published annually by IATA and ICAO, there are no statistics on security, which are available publicly. However, major security incidents and security breaches appear in the media.

Any changes in security threats of a State are shared with other states. This works as a proactive mechanism. But care must be taken about sharing of security information as it is highly confidential and must be shared with relevant and reliable authorities and agencies. Even Doc 8973, the implementation guidelines for the security measures specified in Annex 17 and the National Civil Aviation Security Program of States are restricted documents.

In today's time, the use of CCTVs, behavior detection through analytics, and other modern and advanced measures are being adopted for security checking. Moreover, observing any kind of suspicious behavior or activity can also be a preventive behavior. Intelligence input is also a feature of security reinforcement measures.

Despite all the preventive measures, there were a few incidents reported in the public domain, some of which are mentioned below:

- Eleven people went through an unattended security checkpoint at an airport.
- In India only genuine and actual passengers are allowed inside the terminal. Once they are inside the airport, they cannot leave the terminal unless authorized by airport security. There were many instances where some persons entered the terminal without a valid ticket and while trying to exit the airport were caught and arrested.
- A spokesperson from Adelaide airport said there had been an issue with security screening, meaning some passengers were able to pass through the terminal without proper checks. Hence, passengers from the terminal had to be evacuated and screened again, resulting in flight delays
- In the year 2016, a gun and bomb attack on

Istanbul's Ataturk airport killed 41 people and injured more than 230. Three attackers arrived in a taxi and began firing at the terminal entrance. They blew themselves up after police fired back. In the same year, Brussels airport had a security incident in the departure hall by suicide bombers exploding themselves leaving many dead and injured.

Aviation security management includes regulations, practices, and procedures involving multiple stakeholders. These include such as airlines, airport operators, air navigational service providers, police authorities, security service providers, and intelligence organizations. The main aim of States concerning security is to ensure the protection and safety of passengers and crew members along with.

The general public, aircraft, and facilities at an airport. Apart from security, the State must also take care to maintain an efficient air transport system by the airport operator and airline operator.

Ensuring preventive security measures as per Annex 17 SARPs, implementation as per manual 8973, State's National Civil Aviation Security Program (NCASP) and applicable national and regional laws is the responsibility of the airport, airline operators, and other stakeholders.

Talking about India, it is the responsibility of the Bureau of Civil Aviation Security (BCAS) to take care of Aviation Security Standards in accordance with Annex 17. BCAS also monitors and implements security rules and regulations. Further, it also ensures that the security personnel is well-trained and competent enough to take care of all security matters.

An effective security system can be implemented only if the authorities engage right from the conceptual stage including designing the airport facilities, designing the security systems, laying down operational processes, and hiring competent staff. The planners must develop a holistic approach to address security concerns.

It must be taken care that the security measures do not hinder the comfort of the passengers. There must be a balance to attain passenger facilitation, operational efficiency, and security requirements.

It is assumed that the traffic growth will get double in the next few years. Therefore, this will enhance the need for more security at airports and flights. One should not underestimate the concern for safety and security especially when aviation traffic is bound to increase.

Summary

- ICAO, IATA, and Civil Aviation Authorities (CAAs) such as the Director General of Civil Aviation (DGCA) and Bureau of Civil Aviation Security (BCAS) in India, provide standards, guidelines/ practices, strategic directions to enhance safety and security in Aviation.
- Safety is best managed through a proactive strategy thereby improving safety performance. The foundation for this is based on the implementation of the State Safety Program (SSP), which systematically addresses safety risks.
- Some of the common causes of accidents/ incidents include human factors, environmental factors, ground movement related, airport infrastructure related, and other obstacles in and around the airport resulting in operational restrictions or impact. According to ICAO's latest long-term traffic forecasts, both air passenger traffic and air freight traffic are expected to be more than double in the next two decades and thus, the economic benefits will also grow from the present numbers in terms of employment, etc.
- Aviation security is per se the responsibility of the State but collaboration with all stakeholders of the aviation industry is required for risk-mitigation measures, which maximize the protection to passengers and crew at the same time minimizing disruption, ensuring facilitation to passengers and achieving desired economic benefits.

Unit 2

Overview of Safety Management

Learning Objectives

By the end of this unit, you will be able to:

- Describe State Safety Program (SSP)
- Explain Safety Management System (SMS)
- Know implementing SSP and SMS
- Discuss benefits of safety management

Introduction

The aviation industry is highly susceptible to risks and threats. Hence safety concern is a big issue. Since air travel is prone to accidents and other unfavorable incidents, proactive measures need to be taken to ensure safety management. Safety management practices will enable the State to prioritize activities that can help in attaining security and safety. Efforts should be made to manage steps for safety and security in a disciplined, organized, and focused manner.

Safety Management

A formal and integrated effort towards safety management

activities helps to strengthen the entire program. States can strengthen safety management activities through:

- State Safety Program (SSP).
- Safety Management Systems (SMSs) for its service providers.

A State's Safety Program (SSP) is a broad concept. It is regulated and managed by the State so that the desired level of safety performance level is achieved and maintained in the aviation sector. State safety oversights the system's Critical Elements (CEs) and constitutes the foundation of an SSP.

The responsibilities of the States as a part of safety management include:

- Safety management system obligations
- Accident and incident investigation
- Hazard identification and safety risk assessment
- Management of safety risks
- State safety performance
- Internal communication and dissemination of safety information
- External communication and dissemination of safety information

Another important concept is the Safety Management System (SMS). When SSP is for the States, SMS is for the service providers. These two together address safety risks, improve the safety performance of all the service providers, and eventually improve the safety performance activities of the State.

The SMS provides a systematic approach to the service providers to manage safety. It is possible to enhance and improve safety performance through proactive identification of any unforeseen event, collection and analysis of safety data and safety information, and assessing safety risks on a regular basis. Thus, SMS calls for a proactive approach before any mishap takes place. The service providers effectively manage their activities and get a comprehensive understanding of their role in aviation safety. There are 4 components and 12 elements of the SMS framework.

Annex 19 provides the SARPs for Safety Management. With respect to SSP, SARPs require States to establish the 8 CEs mentioned under SSP and safety management responsibilities. It may be noted that the responsibility includes service providers to implement SMS under Safety Management System obligations.

Service Providers Included in SMS Obligation

SMS is required to be implemented not only by

airports and airline operators but includes all the organizations/ service providers mentioned below and approved by the State:

- An approved training organization.
- Certified operator of airplanes or helicopters authorized to conduct international commercial air transport.
- An approved maintenance organization providing services to operators of airplanes or helicopters engaged in international commercial air transport, in accordance with Annex 6.
- An Organization responsible for the type design of aircraft, engines, or propellers, in accordance with Annex 8.
- An Organization responsible for the manufacture of aircraft, engines, or propellers, in accordance with Annex 8.
- ATS provider, in accordance with Annex 11.
- Operator of a certified aerodrome, in accordance with Annex 14, Volume I.

The SMS approach considers the entire aviation industry as a system. The service providers and their initiatives toward safety are part of this whole system. The State can understand the interactions, and cause and effect, throughout the whole system.

Since it is not possible to build all safety systems in the same way, the State as well as the service providers try to manage the interfaces between different and When SMS is applied in practice, it minimizes the risk of deviations or loopholes in safety parameters.

Safety management responsibility lies with States. It does not mean that the responsibilities of the service providers are transferred to the States. The responsibility lies with the service providers and State performs the oversight of aviation activities.

SSPs and SMSs are customized as per the specific needs of each State or service provider. All components and all elements of SSP/SMS are interconnected and interdependent. SSP and SMS requirements are implemented not only in a prescriptive manner but combined with a performance-based approach.

Implementing Safety Management

Following are the initial steps in implementing SSP or SMS requirements:

- Senior management commitment: The commitment and initiative from the top-level management are of utmost importance, in the absence of which an effective system cannot be established.
- Compliance with prescriptive requirements: For this, it is essential to have a safety oversight to ensure compliance.
- System in place for the licensing, certification, authorization, and approval of individuals and organizations performing aviation activities in their State: The State must have qualified, competent, and trained staff to cater to all issues. Service providers should also have processes in

place to ensure continued compliance with the established prescriptive requirements.

- Enforcement regime: The State should establish an enforcement policy so that different parties can manage and resolve violations.
- Safety information protection: There must be a legal framework to ensure the continued availability and protection of safety data and safety information.

System Description

A brief about the activities and processes of the State and/or service providers is a system description. It helps in the assessment of interfaces for identifying any hazard along with safety risk assessment. It describes the aviation system, within which the organization functions, and the various entities and authorities involved. It encompasses interfaces internal and external to organizations that contribute to the safe delivery of services. The system description provides a starting point to implement the SSP/SMS.

Interfaces are important for safety management. These can be internal or external. States and service providers can manage a high degree of control over any related safety risks after identifying and managing interfaces. Interfaces are thus defined as part of the system description.

After assessing safety risks, the State or service provider may work with other organizations to determine and develop an appropriate safety risk control strategy. When firms work in collaboration, they are able to identify more interface hazards. Collaboration is important since the safety risk perception may vary between organizations.

Moreover, each organization involved must identify and manage hazards that affect the organization. The criticality of the interface may differ for each organization. Each organization might have different safety risk priorities and thus reasonably apply different safety risk classifications.

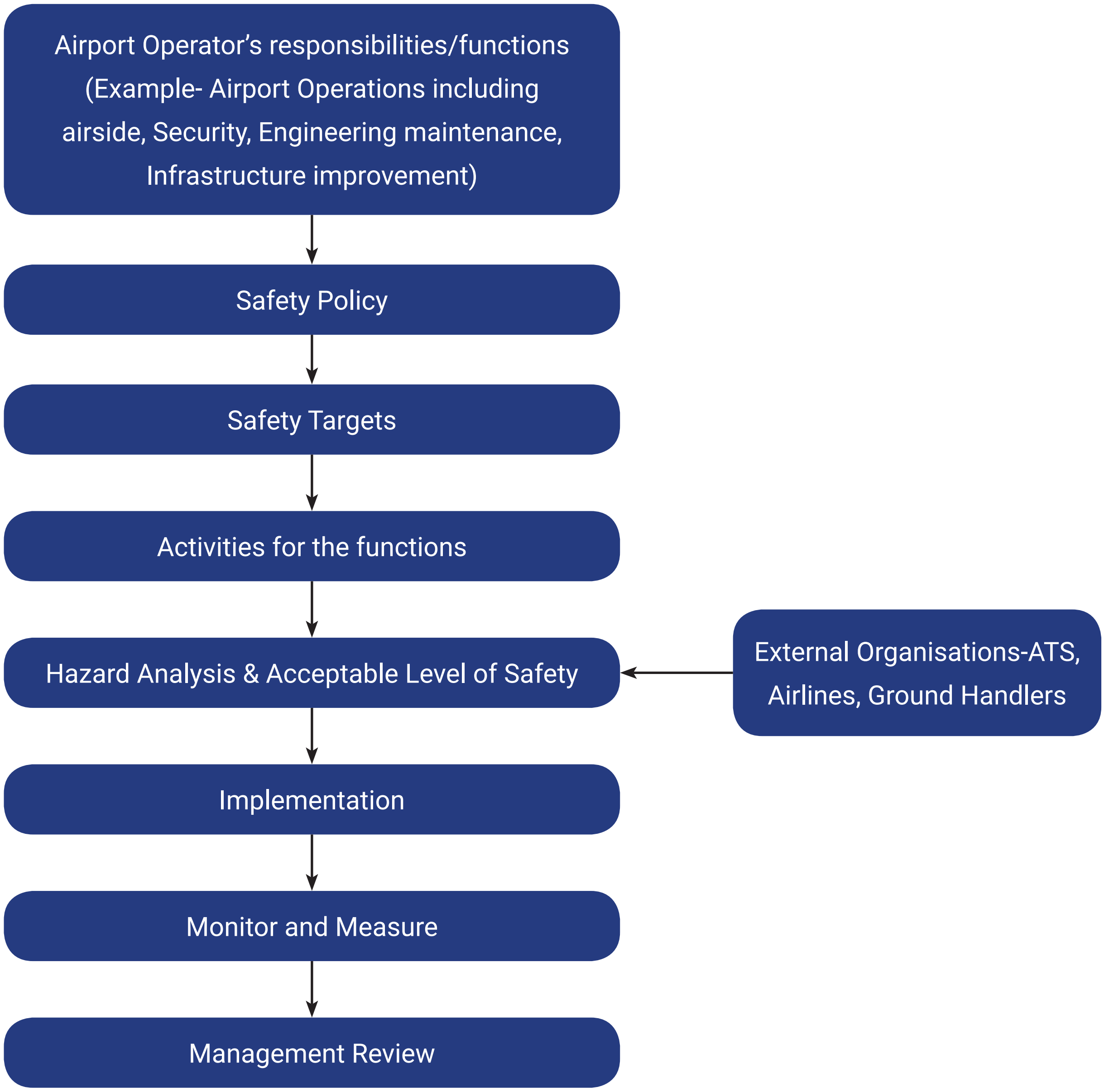
It is essential to monitor and manage interfaces continuously. This can be done by having a formal agreement between the interfacing organizations clearly stating the responsibilities concerned with monitoring and management. Proper documentation ensures clear understanding. Sharing knowledge and working practices can further help to improve the safety effectiveness of each organization.

Before implementing SSP/SMS, it is advisable to identify the gap between the existing organizational structures & processes and what is required. This can be done by reviewing protocol questions in Universal Safety Oversight Safety Audit Program-(USOAP).

SSP/SMS implementation clearly depicts the

resources, tasks, and processes required. It also indicates the correct timing and sequencing of key tasks and responsibilities. Successful risk management in aviation should try to achieve a complete risk reduction in the system. This needs an analytical assessment of the whole system. The assessment and integration of functional system needs and interdependence, are referred to as integrated risk management (IRM).

IRM focuses on the overall risk reduction of the organization through the quantitative and qualitative analysis of both the inherent risks and the effectiveness and impact of sector-specific risk management processes. IRM coordinates and optimizes risk management processes to enable risk reduction. IRM is a distinct high-level concept to leverage the expert advice of sector-specific risk management and provides holistic feedback to achieve the highest level of system performance at a socially acceptable level. Following are the examples of system description by a service provider (Airport):



Benefits of Safety Management

The following are the benefits of implementing safety management:

- It strengthens the safety culture.
- It assures safety with a documented, and process-based approach.
- It helps to understand safety-related interfaces and relationships
- It can help in the early detection of safety hazards.
- It ensures that safety is the prime
- Possible financial savings through reduced insurance premiums.
- Improved efficiencies.
- Cost avoidance due to reduced accidents and incidents.

Summary

SSP is a program that helps to manage the responsibilities of the State when it comes to safety.

The Safety Management System provides a systematic approach to the service providers. This helps them to manage safety in an effective manner. With respect to SSP, SARPs require States to establish the 8 CEs mentioned under SSP and safety management responsibilities. Gap analysis is essential before implementing SSP/SMS. This is done to identify any gap or deviation between the existing organizational structures & processes and that are required for the effective implementation of SSP/SMS.

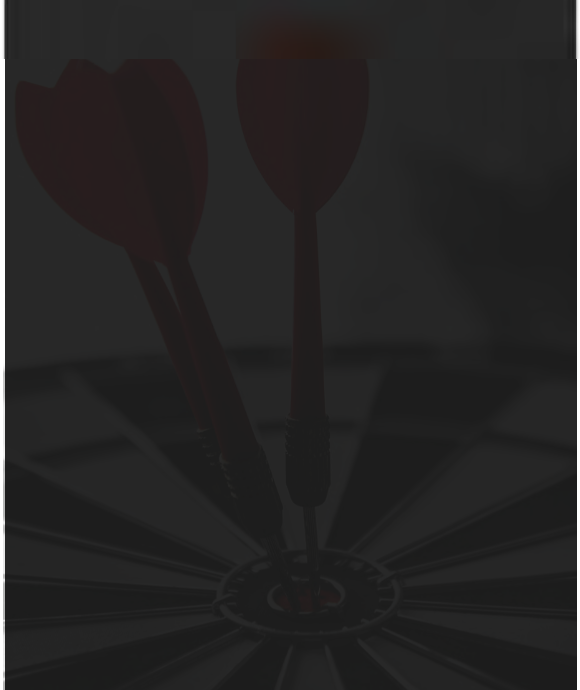
Unit 3

State Safety Program (SSP)

Learning Objectives

By the end of this unit, you will be able to:

- Describe State Safety Program (SSP), its components and elements
- Discuss SSP implementation



Introduction

State Safety Programs are the most important instruments in safety management. If States want to have an effective safety record, safety oversight systems have to be in place. This is when SSP plays an important role to take care of the safety management responsibilities, which includes safety oversight. So, the SSP is an integral part of the concept of State safety management.

State Safety Program (SSP)

SSP is defined as an integrated set of regulations and activities that try to improve safety (ICAO). ICAO makes it mandatory for States to establish as well as maintain an SSP that is appropriate with respect to the size and complexity of the State's civil aviation system.

The States develop and maintain the SSP in order to manage aviation safety performance. Traditionally, safety performance is achieved through a compliance-based approach and continues to be treated as the foundation of the SSP.

The SSP aims to:

- Ensure the State has an effective legislative framework in place with supporting specific operating regulations.
- Ensure Safety Risk Management (SRM) and safety assurance coordination and synergy among relevant State aviation authorities.
- Support effective implementation and appropriate interaction with service providers' Safety Management System (SMS).
- Facilitate the monitoring and measurement of the safety performance of the State's aviation industry.
- Maintain and/or continuously improve the State's overall safety performance.

The establishment and maintenance of the SSP are structured into the following four components and each component comprises various elements as described in table below:

Table: SSP Components and Elements

Component	Elements
State Safety Policy, Objectives, and Resources	Primary aviation legislation
	Specific operating regulations
	State system and functions
	Qualified technical personnel
	Technical guidance, tools, and provision of safety-critical information
State Safety Risk Management	Licensing, certification, authorization, and approval obligations
	Safety management system obligations
	Accident investigation
	Hazard identification and safety risk assessment
	Management of safety risks
State Safety Assurance	Surveillance obligations
	Monitoring a service provider's safety performance
	State safety performance
	Management of change: State perspective
State Safety Promotion	Internal communication and dissemination of information
	External communication and dissemination of safety information

Component 1: State Safety Policy, Objectives, and Resources

Primary aviation legislation: In order to facilitate the State authorities to perform their respective roles, legal compliance is necessary.

Examples of aviation authorities are the Civil Aviation Authority and Accident Investigation Agency. It is imperative for the State to demonstrate and prove its commitment when it comes to handling safety management responsibilities.

Specific operating regulations: To control safety risks, safety regulations are an important tool. These operating regulations can be either prescriptive or performance-based or a combination of these two. Regulations that clearly state what must be done and how it must be done are prescriptive types. It is expected that sincere observance and practice of these regulations can help to achieve the desired level of safety. It has been observed that after any unforeseen event, many prescriptive regulations are developed so that such an event can be prevented in the future. If we see things from the point of view of the service providers, meeting prescriptive requirements requires implementing the regulations without any deviations. The service provider or the authority can in no case justify oneself. Following SARPs from Annex 14 is an example of prescriptive regulation. Non-compliance to this regulation requires an exemption from the Civil Aviation Authority and a deviation to be filed with ICAO

"A runway end safety area shall be provided at each end of a runway strip where:

- the code number is 3 or 4; and
- the code number is 1 or 2 and the runway is an instrument one."

At the same time, the standards which enable performance-based regulations are expressed in terms of the desired outcome without specifying how this will be achieved. In such a scenario, the service provider justifies the proposed approach in attaining the desired outcome.

An example of the performance-based regulation from Annex 14 is as below:

"For a runway meant for use in runway visual range

conditions less than a value of 550 m, the electrical systems for the power supply, lighting, and control of the lighting systems shall be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information."

In this example, the desired outcome is described. There is no indication of the specific scheme or system that can meet this standard. Regulations written in this manner would require the service provider, in this case, the airport operator, to provide the necessary scheme or design elements to the CAA to show it complies with this requirement and the CAA will have to ensure the scheme meets the requirement and confirm its approval or otherwise.

Prescriptive and Performance-based Regulations

In some cases, ICAO SARPs both the prescriptive regulations as well as the performance-based regulations to support alternative means of compliance. When both prescriptive and performance-based regulatory options are established, and if service providers do not have the expertise to develop their own approach to meet the performance-based regulations, they can conform with the prescriptive regulations. However, those service providers who have expertise can develop a means of compliance that suit their operations and may also offer the potential for better operational flexibility and utilization of resources.

State System and Functions

The authority responsible for the maintenance and implementation of SSP is specified by the State. In most cases, this responsibility is given to the Civil Aviation Authority of the State. The roles and responsibilities of all the authorities involved in SSP have to be clearly defined and documented.

The state establishes a suitable coordination group with representation from the impacted aviation authorities with responsibilities related to the implementation and maintenance of the SSP, including Accident Investigation Authorities as well as military aviation authorities. A State can either establish a new office or can give additional responsibilities to the existing offices like the flight operation office, air navigation, and aerodrome office, etc.

State Safety Policies and State Safety Objectives

State safety policies and State safety objectives are authorized by the State aviation authorities. The policies and objectives together lay down the guidelines for safety behavior and resource allocation. It is advisable to regularly publish these policies and objectives so that they remain relevant and appropriate to the State.

State Safety Policy describes

- How committed the senior management is
- The safety intentions of the State

- Attitude of the senior management towards safety concerns

The policy can be seen as State's safety mission and vision statement. State safety policy is endorsed by the State aviation authorities to demonstrate their safety intent and is implemented as a procedure or protocol.

India Safety Policy states – "Employing ICAO standards and recommended practices, as minimum international standards and recommended practices, Directorate General of Civil Aviation (DGCA) will ensure the highest level of safety in the Indian aviation system. Mindful of India's State Safety Program (SSP), DGCA will maintain an integrated set of regulations and activities aimed at enhancing aviation safety.

DGCA will implement proactive and as far as possible predictive strategies encouraging all stakeholders/service providers to understand the benefits of a safety culture, which should be based on an inclusive reporting culture. DGCA will foster and assist stakeholders in developing comprehensive SMS and will develop preventive safety strategies for the aviation system in an environment of a just culture".

DGCA commits to:

- The development of safety culture across all aviation industries and promote the importance of an effective aviation safety management system
- Ensure that safety norms are practiced and safety is of utmost importance
- Establishment of an effective safety reporting and communication system
- Laying down general rules and specific operational policies that build upon safety management principles.
- Ensure that the DGCA financial and human resources are sufficient to implement, establish and maintain SSP. It further ensures the competency of the staff to handle safety-related or any other issues.
- Clearly define the responsibilities and accountabilities of the staff for effective

implementation of SSP and its performance.

- Conduct performance-based as well as compliance-oriented activities
- Ensure that acceptable safety levels are being set. Further, these levels need to be measured and expressed in terms of safety performance indicators and safety performance targets.
- Regular and continuous improvement in the SSP and safety performance.
- Establish effective communication and interaction with service providers in the resolution of safety concerns.
- Keep a thorough check to ensure the establishment and maintenance of the Safety Management System (SMS)
- Ensure the protection of safety data
- Propagate an enforcement policy to make sure that no information derived from any safety data, collection, and processing systems, established under the SMS will be used as the basis for enforcement action, except in the case of gross negligence or deliberate deviation.
- Attain the highest levels of safety standards and performance in aviation operations.

State Safety Objectives

For the effective development of safety risks, it is important to know about the highest safety risks that occur in the aviation system. These risks are influenced by many different factors, for example, the size and complexity of the aviation system It is advisable to use quantitative data if available to develop an understanding of top safety risks. The State may also use qualitative information and expert analysis. Along with this, expert opinions also help to gain an understanding of the main safety risks across the aviation system.

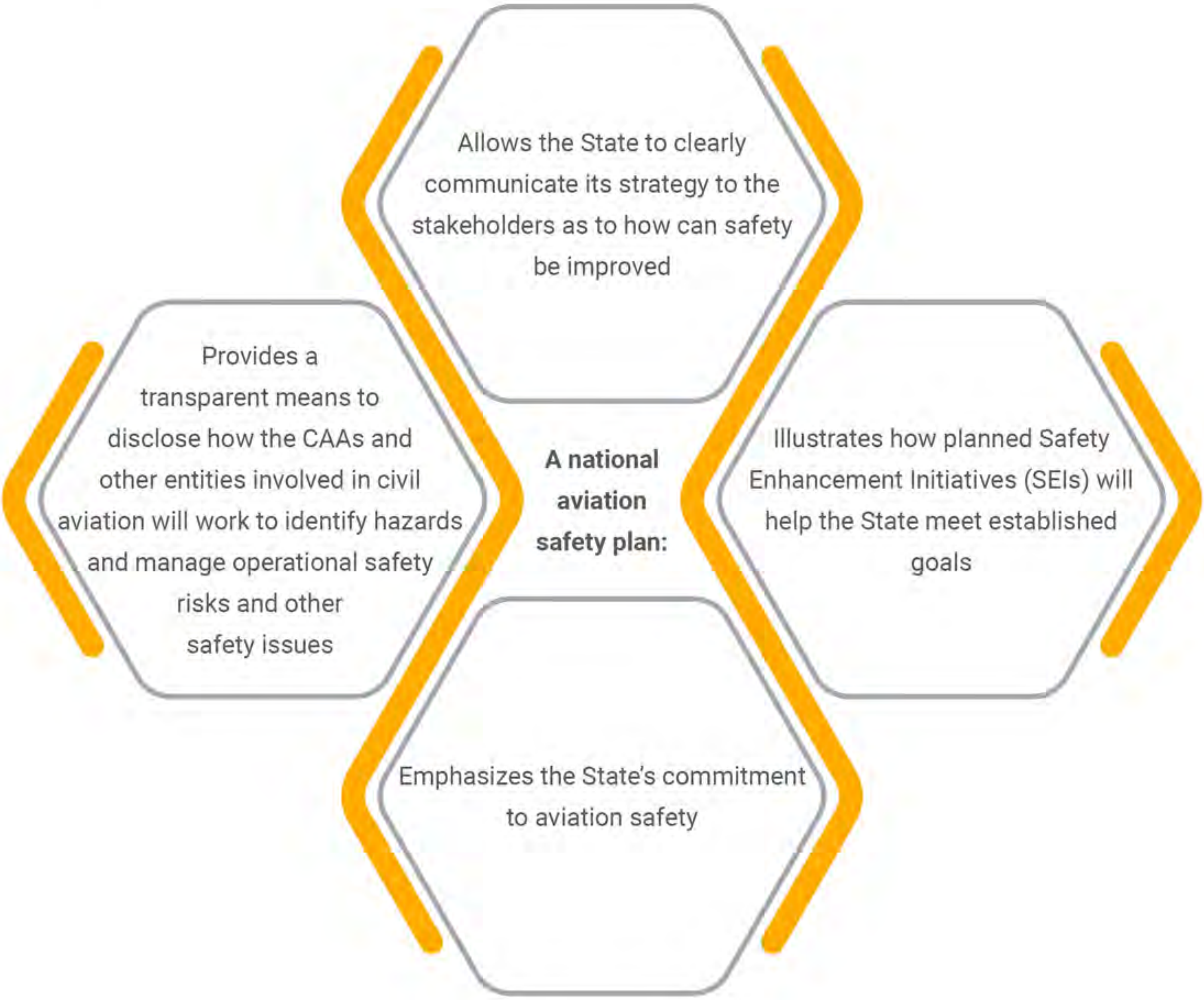
State safety objectives give a brief, but a high-level direction to the concerned State aviation authorities. The objectives help to identify and understand desired safety outcomes that need to be achieved. One should take care to understand the ability of the State to influence the desired outcomes while laying down what is expected. These objectives act as a blueprint that gives an idea about the

State's priorities for the management of safety and how should the available resources be allocated to achieve the same.

The safety objectives help to identify the State's SPIs and SPTs as well as help to establish an acceptable level of safety performance (ALoSP). Safety objectives along with SPIs and SPTs support the State to monitor and measure its safety performance.

National Aviation Safety Plan (NASP)

The national aviation safety plan gives a strategic direction for the management of aviation safety at the national level, for a well-defined time period say for the next five years. NASP gives an idea to all the stakeholders about targeting resources over the coming years.



Internationally, the ICAO Global Aviation Safety Plan (GASP-Doc 10004) sets forth a strategy to support and prioritize the continuous improvement of aviation safety. Regional and national aviation safety plans are developed in alignment with the GASP.

NASP for India is as below:

India has prepared NASP for the years 2018-2022, which is based on the activities defined in the State Safety Program (SSP). NASP is derived from State Safety Policy and State Safety Objectives. SPIs and respective targets will be applicable to all the Aviation organizations/service providers in the State, as appropriate.

The flow chart of NASP for India looks like the following:

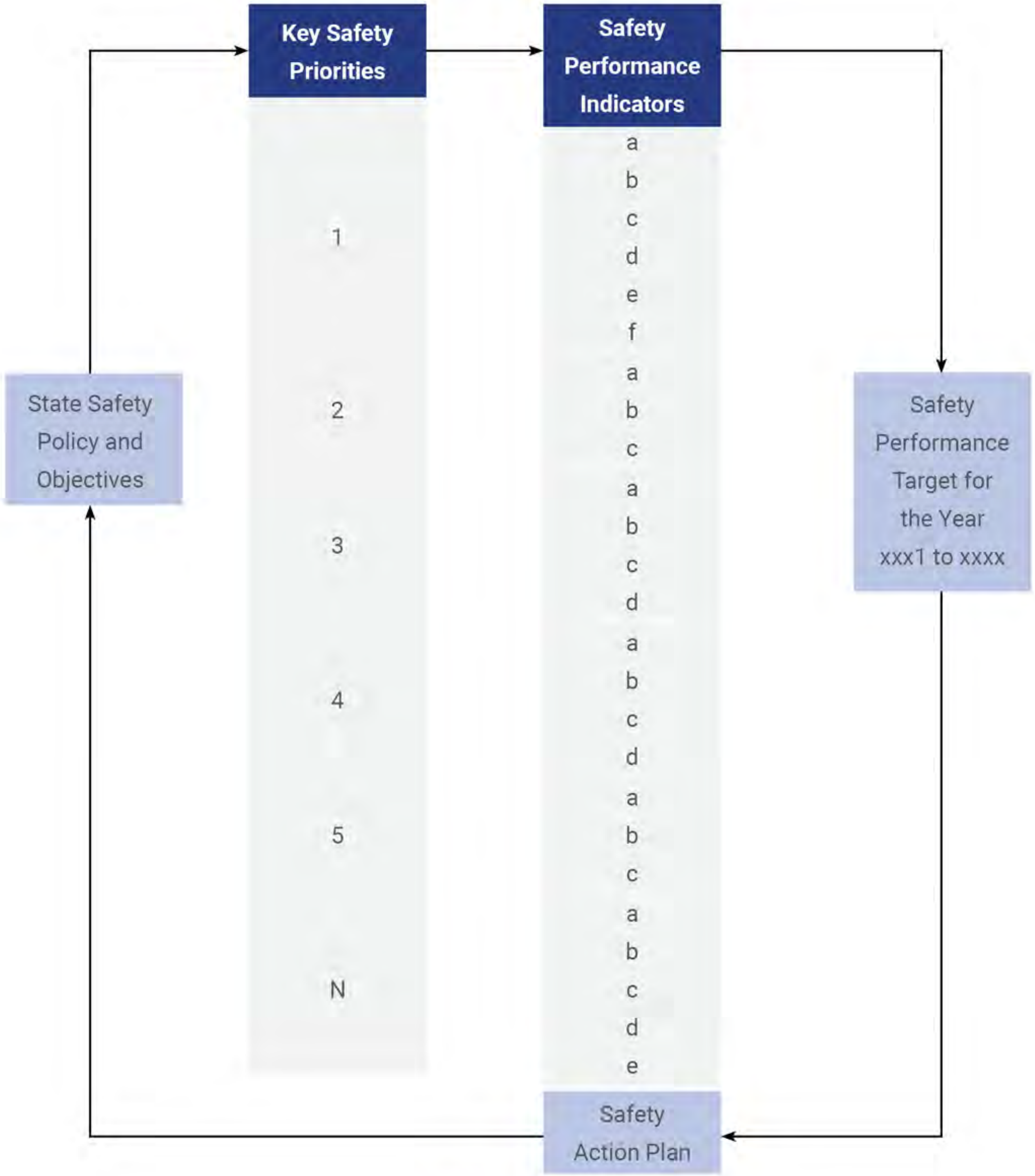


Figure: NASP for India

India has identified 8 key safety priorities (as per National Aviation Safety Plan India 2018-22). For each of the safety priorities, the number of performance indicators will be identified and for these performance indicators targets will be determined year-wise. The performance indicator chosen should be such that these truly reflect the safety priority status.

Let us take one example of safety priority. That is “Runway Excursions and Overruns”. The safety objective for this safety priority is “reduce the number of runway excursions/overruns”. To meet this safety objective, safety performance indicators (SPIs) and targets (Safety Performance Targets – SPTs) for the SPIs are to be determined.

The Safety Performance Indicators for this safety priority are:

- Unstabilized approach.
- Unstabilized approach that continues to land.
- Unstabilized approach while precision approach.
- Unstabilized approach while non-precision approach.
- Unstabilized approach while visual approach.
- Near runway excursion.
- Runway excursion.

The next step is to determine the target for the next few years based on the current value for each of the targets. The targets are set as listed in table below:

Table: Targets

	Actual Y 2017	Target Y 2018	Target Y 2019
Number of Unstabilized Approaches per 10,000 approaches	6.28	6.1	5.91
Number of Unstabilized approaches that continue to land per 10,000 approaches	6.65	6.45	6.25
Number of Unstabilized approaches when performing precision approach per 10,000 approaches	3.52	3.41	3.31
Number of Unstabilized approaches when performing non-precision approaches per 10,000 approaches	1.92	1.86	1.80
Number of Unstabilized approaches while visual approaches per 10,000 approaches	0.76	0.73	0.71
Number of ‘Near’ runway excursions per 10,000 approaches	0.01	0.01	0.01
Number of runway excursions per 10,000 approaches	0.07	0.06	0.05

Even though the safety plan is for five years, the targets are set only for two years and based on the actual value achieved, the targets for the remaining three years will be set. The targets are determined based on the industry standard if there is no historical data available or if the targets are achieved easily from the current value. The safety priority can include regulatory compliance, unlike the operational-related priority. For such priorities, SPIs and SPTs are to be determined. An example of the SPI is regulatory audit findings related to procedures (measured in terms of percentage of total findings). SPT for this says 40% currently and 38% and 37% for the next two years.

Like the above, for the other key safety priorities identified, SPI(s) and SPT(s) will be determined.

SSP Documentation

The State describes its SSP in a document. This helps the concerned personnel to develop a common understanding. The document should include its structure, associated programs show its various components work together, and the roles of the different State aviation authorities. The documentation must align with the existing processes and procedures and clearly describe the integration of different SSPs to improve safety.

Qualified Technical Personnel

States need to identify and address the competencies required for the effective implementation of SSP. States need to assess the roles and responsibilities of the personnel concerned with SSP. In addition to this, the existing staff can be trained to meet any additional requirements. The need for training and type of training is identified by the roles and responsibilities of the personnel. "Manual on the Competencies of Civil Aviation Safety Inspectors" (Doc 10070 of ICAO) provides guidance in this regard.

SSP and SMS training can be in the form of online courses, classroom courses, workshops, etc. The aim is to ensure that each and every concerned person can address each aspect of the SSP, and perform the allocated role. Appropriate and enough training for inspectors will ensure consistent surveillance and required capabilities to be effective in a safety management environment

Technical Guidance, Tools, and Provision of Safety-critical Information

The State can guide its inspectors and service providers to help with the interpretation of safety management regulations. This will help in developing a positive safety culture and also help the service provider to meet the safety objectives. The assessment of SMS may require additional tools to determine both the compliance and performance of the service providers' SMS.

Component 2: State Safety Risk Management (SRM)

It is essential to identify potential safety risks to the aviation system. This can help to analyze the probable causes of an undesirable event. Thus, a proactive approach can be taken. If the State is able to identify the probable contributors to accidents, it can strategically manage safety resources to maximize safety improvements. States should:

- Ensure proper implementation of SMS by service providers
- Establish means to determine whether service providers' SRM is acceptable.
- Review and ensure that the service provider's SMS remains effective.

The SRM component includes the implementation of SMS by service providers, including hazard identification processes and the management of associated safety risks. States should also apply the principles of SRM to their own activities.

Usually, service providers and regulators overlook the safety risk brought through interfaces with other entities. The interface between SSP and SMS(s) can be challenging for States and service providers. The State should therefore highlight the importance of the SMS interface risk management through its regulations and supporting guidance.

Licensing, certification, authorization, and Approval Obligations are important components of the State safety risk control strategy. This is an assurance about the required standards achieved by service operators to operate safely within the aviation system. Some States have established common operating regulations to facilitate the recognition or acceptance of licenses, certificates, authorizations, and approvals issued by other states. Such arrangements do not free the State from its obligations under the Chicago Convention.

SMS of the service providers plays a vital role in Safety Risk Management.

Accident Investigation—A part of State SRM

The accident investigation process has a crucial role in the SSP. The State can identify the factors responsible for any disruption within the aviation system. Thus necessary countermeasures can be generated to prevent any further failure. This will further help in the continuous improvement of aviation safety. Corrective actions can be developed in the light of the obtained information and necessary improvements can be made. ICAO Annex 13 provides more information on this subject.

The Aircraft Accident Investigation Bureau (AAIB) is a division of the Ministry of Civil Aviation, Government of India, which investigates aircraft accidents and incidents in India. Earlier the accident investigation was being carried out by DGCA. ICAO requires that the accident investigation authority (AIA) must be functionally independent of any other organization, particularly CAA to avoid conflict of interest if any.

Management of Safety Risks

The objective of the management of safety risks is to ensure safety risks are controlled and an acceptable level of safety performance is achieved. The appropriate State aviation authority develops, documents, and recommends appropriate safety risk mitigation or safety risk control strategies. Examples include direct intervention with a service provider, implementing additional policies or regulations, issuing operational directives, or influencing safety promotional activities.

An evaluation of each proposed safety risk control should be performed as a next step. Ideal safety risk control candidates are cost-effective, easy to perform, quickly implemented, effective, and do not introduce unintended consequences. Since most situations do not meet these ideals, candidate safety risk controls should be evaluated and selected based on balancing the attributes of effectiveness, cost, timeliness of implementation, and complexity. Once safety risk controls have been selected and implemented, they should be monitored and validated to ensure the intended goals have been achieved.

Many of the safety risk controls require action by the service provider(s). States should direct the service provider(s) to accomplish effective implementation. States may need to monitor the effectiveness of the safety risk controls and their impact on service providers, and collectively, States' safety performance.

Summary

State Safety Programs are the most important instruments in safety management. SSP is defined as an integrated set of regulations and activities that try to improve safety (ICAO). ICAO makes it mandatory for States to establish as well as maintain an SSP that is appropriate with respect to the size and complexity of the State's civil aviation system. The establishment and maintenance of the SSP are structured into four components and each component comprises various elements.

The national aviation safety plan gives a strategic direction for the management of aviation safety at the national level, for a well-defined time period say for the next five years. NASP gives an idea to all the stakeholders about targeting resources over the coming years.

Unit 4

State Safety Program (SSP) (Contd)

Learning Objectives

By the end of this unit, you will be able to:

- Describe State safety assurance
- Explain State safety performance
- Discuss safety performance indicators and safety performance targets
- Know ALoSP
- Describe management of change
- Explain State safety promotion
- Know SSP implementation
- Explain State's civil aviation system description and scalability consideration
- Discuss SSP gap analysis

Introduction

State safety programs are crucial in safety management. The aviation sector is highly risk-prone. Thus, States should ensure an effective safety oversight system. SSP helps States to achieve and maintain safety standards. SSP tries to meet the responsibilities of the State when it comes to safety. So, it is an integral part of the safety management practices of State.

Component 3: State Safety Assurance

Safety assurance activities make sure that the functions of the State achieve the desired safety objectives. Service providers implement the safety assurance process as a part of SMS. SMS assurance capability ensures that the service

providers as well as the State is achieving desired safety protocols with collaborative efforts.

Surveillance activities and collection and analysis of safety data ensure that regulatory safety risk controls are integrated into the SMS of the service providers. This further ensures the proper implementation of activities as designed. States can collect aviation safety data/ information from sources such as surveillance processes and safety reporting programs. The obtained data is analyzed at various levels, and the conclusions so obtained can help in well-informed safety decision-making.

Prioritizing Surveillance Activities

A safety risk-based surveillance (SRBS) approach helps the State to prioritize and allocate resources. States monitor the management of the safety performance of the service providers and gain experience. Over time, the State gets a clear picture of the safety abilities of the service providers. The State may amend the scope and/or frequency of surveillance if it chooses to do so.

SRBS is most appropriate for organizations with a mature SMS. At the same time, SRBS may also be applicable to organizations where SMS has not yet been implemented. An effective SRBS has its basis in reliable and meaningful data, else it would be difficult to cover up any adjustments to the surveillance scope or frequency.

The data management capabilities must be developed so that reliable and comprehensive data is available. This can act as a base for decision-making. Analysis of individual sector safety risks also allows the State to evaluate common safety risks that affect multiple service providers with similar types of operations This facilitates safety risk ranking among service providers within a specific aviation sector or across sectors and supports the allocation of surveillance resources to sectors or activities with the greatest safety effect.

Analysis at the sector level helps the State to view the aviation system. The state can identify the sector(s) that will benefit from a great degree of support. The State can target areas that require assistance to achieve maximum regulatory effectiveness.

SRBS requires ongoing interactions between the State and the aviation community apart from formal audits and inspections. The internal reviews and analysis can address key safety risks. The analysis from both the State and the service provider helps in identifying crucial areas of safety concern and how can these be addressed effectively.

Service Provider Organizational Safety Risk Profiles

States may develop organizational safety risk profiles if they want to sustain the process of modifying the scope and frequency of their surveillance activities. The tools must integrate the available information and may include factors such as:

- The financial health of the organization.
- Number of years in operation.
- Turnover rate of the key personnel such as the accountable executive and safety manager.
- Competence and performance of the accountable executive.
- Competence and performance of the safety manager.
- Results of the previous audit.
- Timely and effective resolution of previous findings.
- Measures of the relative level of activity (exposure to safety risk).
- Indicators of the relative scope and complexity of the activities being performed.
- Maturity of the hazard identification and safety risk assessment process.
- Measures of safety performance from State safety data analysis and performance monitoring activities.

State Safety Performance

Acceptable level of safety performance

Acceptable level of safety performance (ALoSP) is defined as "The level of safety performance agreed by State authorities to be achieved for the civil aviation system in a State, as defined in its State safety program, expressed in terms of safety performance targets (SPTs) and safety performance indicators (SPIs)". (ICAO)

An acceptable level of safety performance (ALoSP) can be achieved through SSP. It is important to

Implement and maintain the SSP

Implement and maintain the SPIs and SPTs

The ALoSP expresses the safety levels that need to be achieved, including the set targets with respect to safety. ALoSP also measures the effectiveness of its own activities and functions that influence safety. ALoSP, thus, reflects what is important and is agreed on by the State level aviation stakeholders. ALoSP should be developed with regard to higher-level strategic guidance and the desired safety objectives.

India ALoSP

1. No fatal accidents in the commercial Air transport operation of airplanes and helicopters including offshore helicopter operations.
2. Implementation of ICAO SARPS effectively and achieving overall effective implementation of 80%.
3. Effective Implementation of State safety priorities, safety performance indicators, and targets.

In order to achieve the ALoSP, it starts with point 3 above and reaches point 1 above i.e., no fatal accidents.

Safety Performance Indicators and Safety Performance Targets

SPIs that reflect the specific operational environment prove meaningful. These SPIs can highlight conditions that can identify how safety risks are being controlled. The State monitoring and

measurement strategy should include a set of SPIs that cover all areas of the aviation system for which the State is responsible. It should reflect outcomes, for example, accidents as well as functions and activities. Will help in a comprehensive and detailed evaluation of safety performance. Practically speaking, this will reflect two distinct types of safety risks:

a) **Operational safety risks:** These risks focus on conditions that could lead to an unwanted outcome. Such conditions are associated with accidents, incidents, failures, and defects. Such risks are by-products of the delivery of services. That is why SPIs that focus on operational safety risk are usually linked indirectly to service providers' SMS. The actual number of operational risks will be based on the situation in each State. These SPIs reflect mainly operational safety issues identified by the SRM process of service providers. The SRM process is used as an input to reflect operational safety issues across the State aviation system derived from the aggregation of service provider operational safety risk SPIs. One operational safety issue may be indicated by several SPIs.

b) **Process implementation safety risks:** These risks focus on the means and resources necessary to manage operational safety risks. This starts with the evaluation of ICAO SARPs implementation status, the implementation of SMS processes within the industry, and the implementation of SSP at the State level. If any of these require any kind of improvement, the required activities need to be planned to achieve the desired results. Resources should be allocated as required and proper monitoring needs to be done. SPIs are then developed that allow tracking of the planning, implementation, and/or effectiveness of the changes.

SPIs focused on "process implementation safety risk" provide the State an alternative means other than strict compliance to monitor the adequacy of SMS institutional arrangement and implementation of SRM/safety assurance processes by service providers. These SPIs may also be established with reference to needed improvements, as shown by USOAP analyses and SSP continuous improvement activities. The results of USOAP audits, aggregation of SMS evaluations, and SSP continuous improvement information determine potential areas for improvement. These should be prioritized according to the greatest benefit. This will contribute to improvement in the State aviation system's safety performance. These SPIs should be distinct from operational safety risk SPIs.

SPIs for both the operational and process implementation safety risks become a key part of the State's safety assurance process. The aggregation of operational safety risk SPIs and process implementation safety risk SPIs broadens the feedback source for establishing the State ALoSP.

Periodic Review of Safety Performance Indicators

After establishing the State SPIs, the periodic review is essential. The available past data can help to identify the top safety risks. However, the aviation system is not stagnant. Over a period of time, new safety issues arise, State processes get changed, and so on. Thus, periodic reviews help refinement of the State safety objectives and consequently the SPIs and SPTs.

Periodic Review of ALoSP

The senior management team responsible for the original ALoSP agreement should determine the continued appropriateness of the ALoSP. The periodic review of the ALoSP should focus on:

- Identifying critical safety issues within aviation sectors, ensuring the inclusion of SPIs that allow safety performance management in these areas.
- Identifying SPTs that define the safety performance level to be maintained or the desired improvement to be achieved for relevant SPI in each sector, with a view to enhancing safety performance management throughout the entire aviation system of the State.
- Identifying triggers (if appropriate) when an SPI reaches a point that requires some action.
- Reviewing SPIs to determine whether modifications or additions to existing SPIs, SPTs, and triggers (if appropriate) are needed to achieve the agreed ALoSP.

When a periodic review of the State's top risks is done, it gives a better and more detailed understanding of the nature of each operational safety issue. The State should consider the probable hazards, and potential consequences and should also analyze how State processes like licensing, certification, surveillance, etc. contribute to SRM.

The evaluation of safety risks helps to identify the safety risk mitigations required. These actions are monitored through SPIs that measure their effectiveness. Improving safety performance of operational safety risk is reactive while improving safety risk management processes is proactive.

Achieving the ALoSP

A State's safety performance as indicated by its SPIs and SPTs demonstrate the ALoSP achieved. If any of the SPTs are not met, an evaluation may be needed to better understand why and to determine what actions should be taken. It could be because:

- The targets were not achievable or realistic.
- The actions taken to achieve the target were not appropriate or deviated from the original intent (practical drift).
- Changes in other safety risk priorities diverted resources away from meeting a particular target.
- Emerging risks occurred that had not been considered when the targets were set.

If any of the targets are not met, one must try to understand the reason behind the same so that further actions can be taken. This may require additional analysis that could identify some risk factors that were not addressed or maybe some risk mitigations in place that are not effective.

Monitoring a Service Provider's Safety Performance

Each service provider's SPIs and SPTs are required

to be reviewed periodically while considering the performance and effectiveness of each SPI and SPT. The review may show the need to make adjustments to support continuous safety improvement.

Management of Change: State Perspective

Annex 19 does not explicitly require a State to establish formal activities for the management of change under the SSP. However, changes are inevitable. Any change can bring about a new risk. Therefore, proper analysis is essential concerning any change that has been introduced in the aviation sector.

An SSP should develop procedures to assess the impact of changes at the State level. These procedures should be such that the State can proactively identify the impact of change on safety in the aviation system before implementing such changes. At the same time, no activity or operation should take place in a changed system until all safety risks are evaluated.

Management Change can be an organizational change (for example, reallocation of responsibilities or restructuring within State aviation authorities) or an operational change (for example, a change in airspace usage).

The management of change under SSP should focus on those changes that have a positive impact on the State's ability to fulfill its legal obligations as well as manage safety issues. This might include a combination of process and operational changes.

It is extremely important to communicate any change that has been incorporated to the affected personnel within the State as well as the affected service provider(s).

Component 4: State Safety Promotion

From the State perspective, the need to implement internal and external State safety promotion action is established in Annex 19 as one of the components of States' safety management responsibilities. Internally, CAAs and other aviation authorities involved with the SSP should establish mechanisms to provide relevant safety information to its personnel to support the development of a culture that fosters an effective and efficient SSP. The communication of its safety policies, safety plans, as well as other important SSP documentation can also improve awareness and collaboration among its staff so that safety management processes put in place by States remain effective.

Any improvement in safety performance within a State or a specific aviation sector depends extensively on its safety culture. Safety management actions can be fruitful only if there exists a culture to initiate and develop safety. When the management supports a safety culture, the frontline employees feel responsible to attain and maintain safety.

Communication plays an important role in establishing a safety culture within an aviation system. It is important to communicate priorities, best practices, and risks that stand out in a particular operation. This will promote a safety culture and maximize the potential of achieving safety objectives.

It is believed that the employees would give their best to achieve safety standards after understanding their responsibilities to do so. Effective communication channels with service providers should enable the sharing of lessons learned, best practices, SPIs, and the provision of information on specific safety risks. This should facilitate the implementation of safety management practices within service providers and further support the development of a positive safety culture among peer organizations.

At the same time, if routine communication is established with service providers, it will increase general awareness of aviation safety issues and encourage safety enhancement initiatives.

States should not only make decisions or take actions to improve aviation safety, but they must also communicate these decisions and actions internally as well as externally. This can strengthen the perception of the State's commitment throughout the aviation community and help in the attainment of State safety objectives.

Many resources and tools support States to establish safety promotion actions. One of the ways by which the State can adopt safety promotion activities can be done by establishing an effective communication plan. The mapping of interested members of the aviation community needs to be done. All the information and messages have to be communicated to the group members involved. The communication plan may also act as a roadmap to facilitate the effective implementation of CAA. This can further contribute to building up a positive safety culture as well as in providing the necessary data and tools required by successful safety management, both from States' perspective as well as from service providers.

Information sharing can be done either formally or informally. Formal communication can be done through meetings and seminars and informal communication can be done through less formal bulletins and posts using social media. The State has to decide upon the right channels to facilitate communication to achieve a positive safety culture and ultimately achieve an effective SSP and a safer civil aviation system within the State.

SSP Implementation

Effective SSP implementation is a gradual process. It needs time to mature fully. Factors such as the complexity of the air transportation system and the maturity of the aviation safety oversight capabilities of the State impact the time required to establish an SSP. SSP implementation involves many tasks and subtasks to be completed within a specified time limit. The number of tasks and the scope of each task depend upon the maturity of the State's safety oversight system. In most States, a number of organizations are involved in the development and implementation of an SSP.

State's Civil Aviation System Description and Scalability Considerations

The size and complexity of the State's aviation system and the interactions between the elements are fundamental to planning the SSP. A State has to implement an SSP, but the implementation depends on the size and complexity of the aviation system.

The SSP will also consider the number of service providers in each aviation domain, their size, complexity, and regional environment. States that have few service providers should consider regional partnerships. This will reduce the impact as well as enhance the benefits of SSP implementation.

The State should describe the aviation system and the various State aviation authorities in a civil aviation system description. This should include an overview of organizational structures and interfaces. This is part of the SSP implementation planning process.

SSP Gap Analysis and Implementation Plan

SSP Gap Analysis

A gap analysis precedes an SSP implementation plan. This helps to get a detailed understanding of the gap between the existing State structures and processes, and what is required. The gap analysis also reveals the existence of a considerable safety management capability in some cases. The further challenge is to refine, realign and strengthen these existing capabilities.

SSP Foundation

An effective SSP implementation calls for a mature foundation. The GASP objectives necessitate States to implement an effective safety oversight system, SSPs and advanced safety management capabilities so that future aviation systems can be supported. This foundation comprises of the aspects of a safety oversight system to facilitate a more performance-based approach.

The loopholes in this foundation can be judged by the data collected through the ICAO Universal Safety Oversight Audit Program. It is important to address and resolve any unsatisfactory USOAP protocol questions before t implementation of SSP.

SSP Implementation Plan

The SSP implementation aims to enhance the existing State Safety Oversight (SSO) and safety management processes. Priority is given to the appropriate tasks/subtasks and these are documented in an action plan. An SSP implementation plan, together with the SSP top-level (exposition) document, acts as a "blueprint", to guide the State's journey toward an effective SSP. These two key documents should be made readily accessible to the concerned members so that everyone is aware of the SSP and its plans. This will support effective implementation.

SSP Maturity Assessment

The assessment of the SSP's maturity should be conducted using a tool that reflects ICAO SARPs and guidance material, developed by the State to meet its needs. States use the tool to conduct internal audits to check for the improvement of the SSP. They should also be referred to by ICAO and other external entities as appropriate. The tool should clearly specify the expectations so that the effectiveness of the SSP can be evaluated. Usually, face-to-face discussions, interviews, and interactions contribute favorably to the SSP maturity assessment. The tool should be flexible and account for the size and complexity of the State's aviation system.

Assessment

After the installation of the basic aspects of the

SSP, an assessment of the documentation can be conducted. The assessment helps to judge if the compliance and performance expectations of the SSP are present and suitable. Evidence should be collected to support the assessment. Henceforth, the SSP helps to understand how effectively it is operating. Effectiveness is directly related to the achievement of desired results. A team with appropriate SSP competence and technical expertise normally conducts the assessment and collects the evidence. It is important to structure the assessment in a way that allows interaction with several people at different levels of the organization. This can help to know about the effectiveness throughout the organization. For example, if one wants to understand if the safety policy has been propagated and clearly understood by staff, one will have to interact with a cross-section of personnel.

Ongoing Monitoring and Continuous Improvement

The State may utilize the same tool to assess the effectiveness of its SSP during ongoing monitoring and continuous improvement. This will help in identifying any changes. For most States, SSP takes time to implement and attain maturity to a level where all the elements are working effectively. An SSP assessment can be done at various stages. At a later stage, the SSP assessment can help in judging its effectiveness in achieving objectives. The assessment can be carried on periodically to support continuous improvement and reach the point of maximum efficiency.

Note: The SSP program of India can be downloaded from the DGCA website.

Summary

- SSP is an integrated set of regulations and activities that strive to improve safety. ICAO mandates States to establish and maintain an SSP that is adequate for the size and complexity of the State's civil aviation system.
- To control safety risks, safety regulations are an important tool. These operating regulations can be either prescriptive or performance-based or a combination of these two. States specify the authority within the State that coordinates the maintenance and implementation of the SSP.
- The ALoSP expresses the safety levels that need to be achieved, including the set targets with respect to safety. ALoSP also measures the effectiveness of its own activities and functions that influence safety.
- The management of safety risks ensures that safety risks are controlled and ALoSP is achieved. The appropriate State aviation authority develops, documents, and recommends appropriate safety risk mitigation or safety risk control strategies.

Unit 5
Safety Management System (SMS)

Learning Objectives

By the end of this unit, you will be able to:

- Decribe components and elements of the ICAO and SMS framework
- Discuss SMS Gap analysis, and implementation

Introduction

"Service provider" refers to any organization that provides aviation services. The term includes approved training organizations that are highly prone to operational safety risks at the time of providing services.

SMS aims to provide a systematic approach to service providers to manage safety. It tries to improve safety performance through:

1. Identification of hazards
2. Collection and analysis of safety data and safety information
3. Continuous assessment of safety risks

The SMS tries to minimize aviation accidents and other unforeseen and unfavorable incidents. It helps service providers to manage their activities and resources to achieve safety standards. An effective SMS effectively contributes to safety management and enhances service providers' ability in this direction.

Components and Elements of the ICAO SMS Framework

The table below shows the components and elements of the ICAO SMS Framework:

Table: Components and Elements of SMS Framework – ICAO

Component	Element
Safety Policy and Objectives	Management Commitment Safety Accountability and responsibilities Appointment of key safety personnel Coordination of emergency response planning SMS Documentation
Safety Risk Management	Hazard Identification Safety Risk assessment and mitigation
Safety Assurance	Safety Performance monitoring and measurement The management of change Continuous improvement of the SMS
Safety Promotion	Training and Education Safety Communication

Component 1: Safety Policy and Objectives

The first component of the SMS framework lays down emphasis on creating an environment where safety management can be effective. The policies and objectives concerning safety are laid to depict the commitment of the senior management.

An effective SMS is possible if supported by senior leadership and committed management. It is depicted through the establishment of safety objectives. The decisions of the management and allocation of resources should be consistent with the safety policy and objectives so that a positive safety culture can be established.

The safety policy needs to be developed and recognized by senior management. The concerned executive needs to sign the policy. At the same time, consultation with key staff members, staff representatives, members of trade unions and employee forums, and other important personnel is

important. This promotes a culture of participation and shared responsibility.

The policy also includes a safety reporting system and specifies the disciplinary policy in case safety events or issues are reported.

Safety objectives specify the aim of the organization for achieving safety outcomes. These are high levels statements of the organization's safety priorities based on the history of safety performance and its most significant safety risks. To monitor whether these objectives are achieved, Safety Performance Indicators (SPI) and targets for these indicators i.e., Safety Performance Targets (SPT) are defined. It is advisable to review safety policies periodically to ensure their relevance over a period.

Management Commitment is the core of SMS and this should be made visible to the entire organization by endorsing the policy by the Senior Management and communicating to all personnel so that they understand and perform their functions according to the safety policy.

An Example of Safety Policy of an Airport

"Airport will proactively act for prevention of accidents and incidents, injuries through compliance of all legal and regulatory requirements, voluntary hazard reporting and safety risk assessment and management by allocating appropriate resources and ensure continuous safety performance improvement."

Signature / Name of the CEO / Airport Name

An Accountable Executive owns decisive authority over safe operations in the organization. The Accountable Executive:

- Is responsible for establishing and promoting safety policy and objectives.
- Has the authority to make decisions, and have control of financial aspects and human resources
- Chairs the safety review meetings to reinforce his visibility and commitment to the process.
- Cannot delegate certain functions. These include laying down acceptable safety risk limits, budget allocation and other resources, training activities, and so on.
- Has clearly identified accountability and responsibility.

Typically, Chief Executive Officer is designated as Accountable Executive. All the personnel working in the safety-related functions of the operations will also have clearly defined accountability and responsibility. These must be clearly communicated across the organization and get reflected in the SMS document. It is important that every senior manager actively participates in the operation of SMS since safety is the most important element.

SMS of one service provider may have an interface with another service provider when they together perform an activity. This is required to be considered while defining the accountability and responsibility of the personnel.

The Safety manager is appointed to facilitate the effective implementation and functioning of SMS.

The desired qualities in a safety manager usually include experience (quality management as well as operational), and required technical skills.

Safety committees are also established by service providers so that support can be extended in the implementation of SMS functions across the organization.

Safety strategies can be effectively implemented by creating safety action groups (SAGs). These groups are operationally focused and comprise managers and front-line personnel and are chaired by a designated manager. SAGs deal with specific implementation issues consistent with the strategies developed by the Safety Review Board (SRB).

An Emergency Response Plan (ERP) is an essential component of a service provider's Safety Risk Management process. ERP addresses emergencies and critical events related to aviation. The ERP should deal with probable emergencies as identified through the SMS and include mitigating actions, and controls to effectively manage such crucial emergencies related to aviation.

The SMS documentation includes a top-level "SMS manual". The manual should include a comprehensive description of the policies, processes, and procedures of the service provider and also the under-mentioned information:

- Safety policies as well as objectives
- Reference to any applicable regulatory SMS requirements
- System description
- Accountable personnel for safety
- Procedures for safety reporting system
- Identification of hazards and process for safety risk assessment
- Procedures for safety investigation
- Procedures for SMS training and communication process

- Procedures and processes for safety communication
- Procedures for internal audits
- Management of change procedures

The SMS manual serves as a safety communication bridge between the service provider and key safety stakeholders. DGCA India has published an Advisory Circular for the establishment of an SMS Manual for the service providers with guidelines. The SMS manual is a controlled document, that must be up-to-date. It is essential to have CAA approval when this document is prepared for the first time, and also if any significant amendments are to be made to the SMS manual.

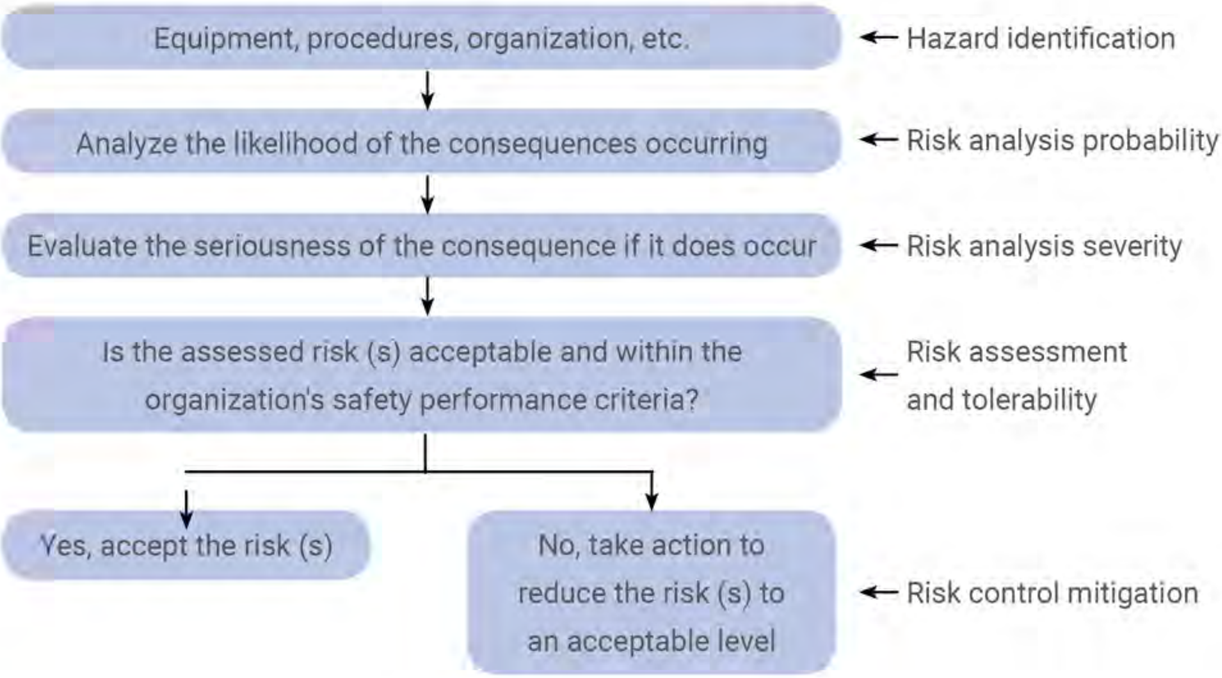
Another SMS documentation is the compilation and maintenance of operational records to verify the existence and ongoing operation of the SMS. Operational records are the outputs of the SMS processes such as the SRM and safety assurance activities. SMS operational records should be stored and maintained in compliance with existing retention periods.

A typical operational record will comprise of:

- Hazards register and hazard/safety reports
- SPIs and related charts
- Record of completed safety risk assessments
- SMS internal review or audit record
- Internal audit records
- Records of SMS/safety training records
- SMS/safety committee meeting minutes
- SMS implementation plan (during the initial implementation)
- Gap analysis to support the implementation plan

Component 2: Safety Risk Management

Service providers must be sure about the management of safety risks. This process is known as safety risk management (SRM). The process includes hazard identification, safety risk assessment, and safety risk mitigation.



Source: ICAO

Service Provider Safety Investigation

The quality of investigations plays an important role in effective safety management. The investigation helps to analyze safety occurrences and safety hazards. It further helps in making recommendations to improve safety in the operating environment.

Accident and incident investigations and safety investigations by the service provider are different. Investigation of accidents and serious incidents under Annex 13 is the responsibility of the State, as defined in Annex 13. Such investigation reports from accidents and serious incidents are publicized to learn lessons from them.

Safety investigations are conducted by service providers. This is a part of their SMS to identify hazards and support risk assessment processes. Many safety occurrences fall outside of Annex 13 that could provide a valuable source of hazard identification or identify weaknesses in risk controls. These problems might be revealed and remedied by a safety investigation led by the service provider.

The service provider conducts a safety investigation to understand what happened, and how can such incidents be minimized and eliminated. Careful analysis is done so that future recurrence gets reduced.

Such investigations are a crucial component of the service provider's SMS.

The benefits of conducting a safety investigation include:

- To get a better understanding of the events that lead to the occurrence.
- To get a better understanding of human, technical and organizational factors that play a contributing role

- To identify hazards and conduct risk assessments.
- Make necessary recommendations so that unacceptable risks are minimized
- Identify lessons to be shared with appropriate members

A service provider safety investigation is usually activated by a notification (report) submitted through the safety reporting system.

Component 3: Safety Assurance

As per ICAO/Annex 19, service providers develop and maintain the means to verify the safety performance of the organization and to confirm the effectiveness of safety risk controls. This is done through the safety assurance component of the service provider's SMS.

Safety assurance includes those processes and activities that determine if the SMS is operating as per what is required. This is done through continuous monitoring of the processes and the operating environment. This helps to detect any changes that can either degrade the current safety risk controls or introduce emerging safety risks. These deviations can be addressed through the SRM process.

Safety performance monitoring and measurement verifies the safety performance and confirms the effectiveness of safety risk controls. This is done through internal audits and also by establishing and monitoring Safety Performance Indicators (SPIs). It is important to note that the application of safety risk controls does not always yield desired results. Hence, their assessment helps in identifying if the right safety risk control was selected or not.

Internal audits verify the effectiveness of the SMS as well as identify areas that need to be improved. The main focus of the internal audit is on the policies, processes, and procedures that provide safety risk controls. Internal audits prove effective when they are conducted by those who do not belong to the departments that are being audited. Internal audits should monitor progress in closing previously identified non-compliances. These should have been addressed through root cause analysis and the development and implementation of corrective and preventive action plans.

The results obtained from the analysis of cause(s) and other contributing factors for any non-compliance should feed into the service provider's SRM processes. CAAs may provide additional feedback on the status of compliance with regulations and the effectiveness of the SMS.

Safety Performance Monitoring

This is done by collecting safety data and safety information from different sources typically available to an organization. The purpose of safety performance monitoring is to verify the effectiveness of safety risk controls and also to provide a measure of the integrity and effectiveness of SMS processes and activities.

Safety Performance Indicators (SPIs) measure the operational safety performance of the service provider and the performance of their SMS. SPIs monitor the available data obtained from various sources including the safety reporting system.

The service providers must consider the following factors while establishing SPIs:

- SPIs derived from the State Safety Program (SSP)
- Determine the best SPIs to verify that the organization is on track when it comes to the attainment of safety objectives. Also, consider what are the biggest safety issues and safety risks that an organization faces and identify SPIs, which will show effective control of these
- Data should be reliable. Unreliability in data occurs either because of its subjectivity or because it is incomplete
- Agree on common SPIs with similar organizations to facilitate comparisons

Safety Performance Targets (SPTs) for each SPI also help to monitor the performance. SPT may also include alert levels. SPTs also will follow the target set by the State in their SSP.

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

- **Safety studies** to get an intensive understanding of safety issues.

- **Safety data analysis** uses safety reporting data to uncover common issues or trends that might warrant further investigation.
- **Safety surveys** examine procedures related to a specific operation. The surveys can be done using, questionnaires and informal confidential interviews. Usually, qualitative information is obtained from these surveys. Surveys are inexpensive and valuable sources of safety information.
- **Safety audits** assess the integrity of the service provider's SMS and supporting systems. Audits also evaluate the effectiveness of installed safety risk controls. However, an effective audit system should engage external entities while taking care of policies, procedures, and communication protocols.
- **Findings and recommendations** from safety investigations can provide useful safety information that can be analyzed against other collected safety data.

The Management of Change

Several factors can bring about changes in the organization. These could be expansion or contraction of the organization, business improvements that affect safety, changes in the operating environment, changes to the SMS interfaces with external organizations, regulatory changes, economic changes, and emerging risks. These changes affect the current safety risk controls. At the same time, a new hazard can occur due to any change in the existing setup. It is important to identify these hazards and control them.

The change management process should include the given activities:

- Understand why a change is being implemented and description of the change
- Understand the impact of change and on whom. Change can affect individuals within the organization, departments as a whole, and even external members that are related directly or indirectly. Even the equipment, procedures, processes, etc. can get affected.
- Understand who should be involved in the change
- Identify hazards that might occur due to any changes. One must carry out a risk assessment to identify any hazard that occurs due to an amendment. At the same time, the degree of impact should also be analyzed.
- Develop an action plan to define what needs to be done, how it should be done, and who should do it. Establish a clear plan to describe the implementation of change.
- Define the responsibilities and accountability of persons for actions taken. Proper sequencing and scheduling of each task need to be done.
- The person having the responsibility and authority for implementing any change must sign the change plan. This ensures that the plan is safe to implement.
- Determine if any follow-up action is required. Effective communication should be there to describe the change. Also, determine if there is a need for any additional activities before or after

the change. In case of any assumptions being made, these must be tested.

Continuous Improvement of the SMS

As per Annex 19, service providers should monitor and assess SMS processes. This helps in maintaining and improving the effectiveness of the SMS. This can be done by various methods like audits, assessments, safety surveys, management reviews, etc. Evaluation of SPIs and SPTs also helps improve the SMS's continuous improvement. Lessons learned from safety reporting systems and service provider safety investigations should also be addressed and analyzed.

Continuous monitoring and internal auditing help service providers improve safety performance. Ongoing monitoring of the SMS and related safety control measures ensures that the safety management processes are in the right direction to achieve desired objectives.

Component 4: Safety Promotion

Safety management can be effectively promoted through training, education, and two-way communication across all levels of the organization. Merely strict adherence or compulsions won't suffice. Efforts have to be taken to promote safety management. Safety promotion affects both individual and organizational behavior. There has to be a willingness to implement it.

Annex 19 requires that the service providers develop and maintain a safety training program to ensure that the concerned staff is trained and competent enough to perform duties. It also requires that "the scope of the safety training program be appropriate to each individual's involvement in the SMS".

The safety managers have to ensure that the staff is getting adequate and required training to achieve the desired competencies to perform specific tasks. Appropriate safety information must be imparted to meet specific safety issues. Trained members should perform their SMS duties irrespective of their position and level in the organization.

Before the training is organized training needs analysis is required to be carried out with the knowledge and competencies needed to perform safety duties and carry out a gap analysis for the staff involved in safety duties. Once the gap analysis is completed, can identify the areas of training needs and thus prepare an appropriate training program with contents and schedule.

Training needs analysis to be carried out regularly to ensure the staff is competent to carry out the safety duties. Identification of competent trainers within the organization or from an external organization is the next step based on the training needs. A specific training program may be needed for the responsible executives and safety managers.

Safety Communication

The SMS objectives of the organization should be communicated to all appropriate personnel. A proper communication strategy should be established. The most appropriate method of communication needs to be selected so that information is conveyed in its clear sense. Communication channels could be safety newsletters, notices, bulletins, briefings, or training courses. At the same time, lessons learned from past experiences should be included in the communication for better understanding. The effectiveness of the communication strategy can be checked through internal audits and SMS effectiveness evaluation.

SMS Implementation Planning is an integration of various management systems including a system description, interface management, and SMS scalability. A system description identifies the organizational processes and helps in defining the scope of the SMS. This helps in better management of safety risks and safety risk controls.

In an SMS, any product, people, process, procedure, facility, service, or any other component of the organization can affect its aviation safety activities. A system is composed of many subsystems. The interaction between these and between systems can be a source of hazards. The important systems include those that directly affect the safety of aviation and also those that impact the ability of the organization while implementing safety management. It is expected that an SMS should be implemented that performs for its unique situation.

The organization must be clear about its intentions as to how it would achieve its objectives. Therefore, it is advisable that an organization prepares a system description to describe its structure, procedures, processes, and arrangements that are core to safety management functions. System description will help organizations to frame policies and

procedures that establish unique and own safety management requirements. A brief idea about the system description and the SMS interfaces should be mentioned in the SMS documentation.

Safety risks faced by service providers get affected by internal interfaces or external interfaces. Internal interfaces exist between departments that are directly associated with safety and those that provide support services like HR, finance, etc. External interfaces exist between other service providers. The service provider can gain more control over safety risks related to the interfaces by managing both internal and external interfaces. These interfaces should also be included in the system description.

After identifying SMS interfaces, the service provider now needs to identify any hazards related to the interfaces to carry out a risk assessment. When safety risks are identified, service providers can collaborate with other organizations to determine an ideal safety risk control strategy. It is the responsibility of the service provider to manage and monitor interfaces to ensure the safe provisions of products and services.

SMS Scalability

The organization's SMS should reflect the size and complexity of the organization and its activities. The service provider should be aware of the right level of resources that would be required to manage the SMS. Irrespective of the size of the service provider, scalability should also be a function of the intrinsic safety risk of the service provider's activities.

The analysis of safety data and safety information is a part of SMS. It is different for small and big organizations. Small service providers find it difficult to identify changes in safety performance due to the low volume of data. Therefore, it is advisable to have meetings and discussions with appropriate experts about safety issues. At the same time, information sharing can be done with similar organizations to compare safety performance trends. Contrary to this, service providers with many interfaces have to consider how to gather safety data and acquire safety information from other organizations. This generates huge data and needs thorough analysis.

Organizations can think about the integration of management systems like QMS, EMS, and SMS. This will remove duplicity. It will also improve efficiency by:

The challenges of management system integration include:

- Conflicts can arise since existing systems may have different functional managers
- Staff members can resist change as they might get affected by the integration
- Different cultures exist in organizations, hence the overall can get affected
- Regulations may prevent integration as different regulators may have different expectations
- Integrating different management systems (such as QMS and SMS) may create additional work

QMS and SMS

QMS can be defined as the organizational structure and related accountabilities, resources, and processes that are required to incorporate and maintain a system of continuous quality assurance and improvement while delivering a product or service.

SMS is concerned with safety management including necessary accountabilities, resources, and policies.

Both QMS and SMS complement each other. When QMS focuses on compliance with regulations and requirements to meet customer expectations, SMS focuses on the management of safety risks and safety performance.

SMS lays emphasis on:

- Identifying safety-related hazards facing the organization.
- Assessing associated safety risks.
- Implementing effective safety risk controls to lessen safety risks.
- Measuring safety performance.
- Maintaining an appropriate resource allocation to meet safety performance requirements

QMS lays emphasis on:

- Complying with rules and regulations
- Maintaining consistency in the delivery of products and services.
- Meeting the specified performance standards
- Delivering error-free products and services

Since QMS and SMS are complementary to each other, their integration is possible without compromising the functions of any of these.

SMS Gap Analysis and Implementation

A gap analysis should precede the implementation of SMS. Gap analysis compares the service provider's existing safety management processes with the SMS requirements as mentioned and determined by the State. While developing an SMS, care should be taken to consider the existing organizational policies and processes.

The gap analysis identifies the gaps so that these can be addressed through an SMS implementation plan.

Summary

- SMS aims to provide a systematic approach to the service providers to manage safety. An effective SMS can be implemented if management is committed to it. The SMS documentation includes a top-level "SMS manual" that includes a comprehensive description of the policies and procedures of the service providers.
- Safety performance is monitored with the help of available safety data and safety information.
- Safety management can be effectively promoted through training, education, and two-way communication across all levels of the organization. Merely strict adherence or compulsions won't suffice.
- Safety risks faced by service providers get affected by internal interfaces or external interfaces. After identifying SMS interfaces, the service provider now needs to identify any hazards related to the interfaces to carry out a risk assessment. When safety risks are identified, service providers can collaborate with other organizations to determine an ideal safety risk control strategy.
- QMS and SMS complement each other. When QMS focuses on compliance with regulations and requirements to meet customer expectations, SMS focuses on the management of safety risks and safety performance.
- A gap analysis should precede the implementation of SMS.

Unit 6

Safety Risk Management

Learning Objectives

By the end of this unit, you will be able to:

- Describe safety risk management
- Discuss meaning of hazard
- Learn hazard identification and prioritization
- Explain hazard identification methodologies

Introduction

The aviation system is dynamic and extensively prone to changes. Thus, SRM tends to be a continuous activity. Due to significant changes, new hazards may come to know. Also, existing hazards change with time. Thus, the safety risk mitigation strategies have to be monitored so that these prove appropriate with types of hazards and also to determine if further action is required.

Safety Risk Management (SRM)

SRM is an essential component of safety management and includes:

What is Hazard?

Hazard is defined as “A condition or an object with the potential to cause or contribute to an aircraft incident or accident”: (ICAO)

In aviation, a hazard is a potential for harm that can exist in various forms. For example, it may be a natural condition like terrain or can be manmade like a communication tower. Since hazards are certain, it is important to identify these so that steps can be taken to lessen their impact. The adverse effects can be handled to some extent through mitigation strategies. Therefore, the identification of hazards is the first step in the SRM process.

Understanding Hazards and their Consequences

Identification of hazards means figuring out those conditions that can impact the safe operation of aircraft or interrupts aviation safety-related equipment, products, and services.

A consequence is an outcome that can be triggered by a hazard. If a hazard is clearly identified, the consequences can also be easily identified.

An immediate outcome of the hazard while landing with a large crosswind during a storm could be loss of lateral control first followed by a consequent runway excursion and the ultimate consequence could be an accident.

A hazard can lead to more than a single consequence. Therefore, it is important to identify all possible and probable consequences. This will help in risk assessment and taking steps to minimize the adverse effects.

The extremely adverse effect would be the loss of human life. However, it should be separated from other impacts that do have an adverse effect but are minimal in comparison to the loss of human life, for example, passenger discomfort or other aircraft incidents are harmful but not as intense as the loss of human life.

Thus, an estimate of all possible effects due to any hazard can help in risk assessment and implementation of mitigations by prioritizing resources and taking preventive measures.

Hazard Identification and Prioritization

As mentioned earlier, hazards exist everywhere and are inevitable. However, these can be detected with the help of many sources such as reporting systems, inspections, audits, brainstorming sessions, and expert judgment. The purpose of detection is to prepare oneself with proactive measures before any major mishap occurs. The voluntary safety reporting system is an important mechanism for the proactive identification of hazards. The information so obtained is supplemented by observations and findings recorded during regular audits.

A good source for hazard identification is a review of investigation reports. These reports could either belong to their own organization or other organizations. If any mishap or accident is reviewed, the scope for hazard identification increases. One can identify the potential hazards and causes for the same.

Another important source for hazard identification can be external sources like ICAO, trade associations, or other international bodies.

Identification of hazards considers not only those related to internal aspects but also those that are external to organizations, for instance, extreme weather or volcanic ash. Organizations can also prepare for unforeseen situations from safety risks learned from the operations.

Important considerations while identifying hazards:

- System description
- Design factors, including equipment and task design
- Physiological, psychological, physical, and

cognitive limitations that impact human performance

- Procedures and operating practices
- Communication channels and degree of an effective communication
- Organizational factors related to recruitment, training, employee retention, safety goals, allocation of resources, safety culture in the organization, etc.
- Operational factors like weather, temperature, lighting, etc.
- Extent of enforceability of rules and regulations and other regulatory factors
- Performance monitoring systems to detect practical drift, operational deviations, or a worsening of product reliability
- Human-machine interface factors
- Factors related to the SSP/SMS interfaces with other organizations

Hazard Identification Methodologies

These include both reactive and proactive methodologies.

In the reactive methodology, an analysis of past events is done. Trend monitoring is also a part of the reactive methodology. Since accidents depict a flaw in the system, these can help to identify and determine the cause of the hazard.

In the proactive methodology, safety data of lower consequence events are collected. The frequency of occurrence is evaluated to depict if a hazard could lead to an accident or not. Proactive methodologies include safety surveys, operational safety audits, safety monitoring, and safety assessments, as well as Flight Data Analysis (FDA), Line Operations Safety Audit (LOSA), and Normal Operations Safety Survey (NOSS). All these methods play an important role in proactive hazard identification.

A combination of reactive and proactive methodologies proves highly effective in hazard identification. A thorough investigation of an incident is, however, still one of the main contributors to identifying hazards. In a successful safety management process, the proactive approach to identifying hazards is extensively used so that a hazard can be identified and handled before any unacceptable event occurs.

Scope of Hazards in Aviation

The scope of hazards existing in the aviation environment is highly extensive. Identification of hazards is quite complex as there are numerous sources and causes of failures and mishaps. Different factors need to be considered for identifying hazards depending upon the nature, size, and operational environment of the organization.

Given below are a few examples of common hazard sources in aviation:

- Design factors including equipment design and task design
- Operating practices, documentation procedures, and validation of documents and checklists

under actual operating conditions

- Mode and medium of communication
- Company policies concerning recruitment, training, and remuneration of the personnel
- Work environment factors like noise and vibration, temperature, lighting, etc.
- Availability of protective equipment and clothing
- Applicability and enforceability of regulations and other regulatory factors like certification of equipment, personnel, and procedures and adequacy of surveillance audit
- Provision of adequate detection and warning systems and error tolerance of equipment

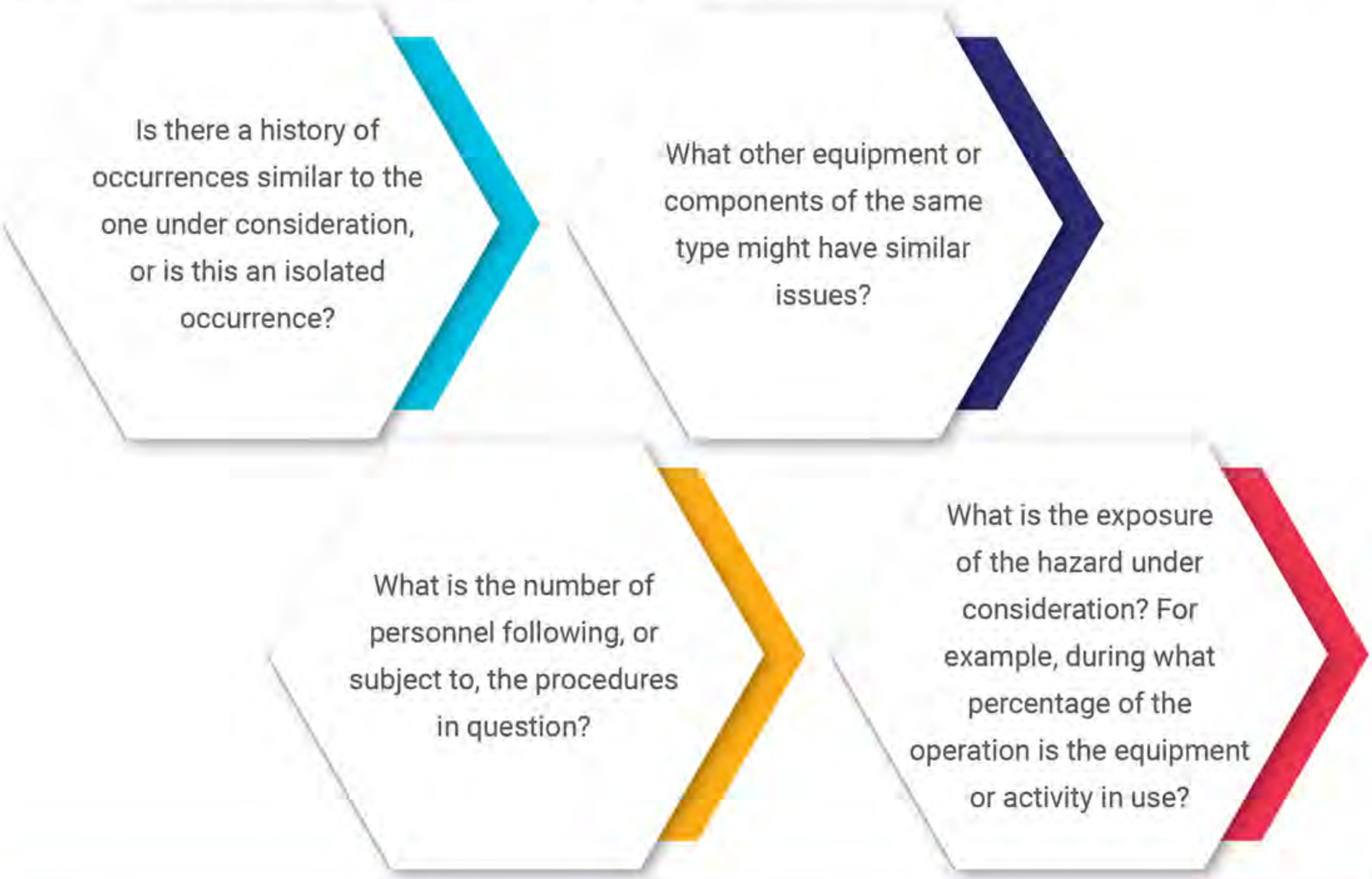
Hazards Related to SMS Interfaces with External Organizations

Organizations also identify hazards related to their safety management interfaces. This has to be a joint exercise with the interfacing organizations. Identification of hazards should consider the capabilities of the organizations and the environment in which these are functioning.

For instance, when an aircraft is on the apron, there are numerous ongoing activities like cleaning, baggage loading/unloading, passengers boarding/deboarding, etc. These activities are carried out by different agencies. There may be a conflict and hazards can exist due to the interface between these agencies.

SRM is based on safety risk probability and severity. By safety risk probability, we understand the likelihood of a safety consequence to take place, whereas, safety risk severity is the extent of harm that might occur due to an identified hazard.

The following questions can assist in the determination of probability:



The analysis of these questions can help to understand any event that might occur. However, since the identification of every conceivable possible hazard is not possible, hence a good and experienced judgment is required. Service providers should exercise due diligence when significant foreseeable hazards are to be identified.

The given table presents a safety risk probability classification depicting five categories to denote the probability related to an unsafe event or condition.

Table: Safety Probabilit

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

Summary

Hazard is defined as "A condition or an object with the potential to cause or contribute to an aircraft incident or accident": (ICAO. In aviation, a hazard is a potential for harm that can exist in various forms. Since hazards are certain, it is important to identify these so that steps can be taken to lessen their impact. The adverse effects can be handled to some extent through mitigation strategies. Therefore, the identification of hazards is the first step in the SRM process.

Hazards can be detected with the help of many sources such as reporting systems, inspections, audits, brainstorming sessions, and expert judgment. The purpose of detection is to prepare oneself with proactive measures before any major mishap occurs. Identification of hazards considers not only those related to internal aspects but also those that are external to organizations.

The scope of hazards existing in the aviation environment is highly extensive. Identification of hazards is quite complex as there are numerous sources and causes of failures and mishaps. Different factors need to be considered for identifying hazards depending upon the nature, size, and operational environment of the organization.

Organizations also identify hazards related to their safety management interfaces. This has to be a joint exercise with the interfacing organizations. Identification of hazards should consider the capabilities of the organizations and the environment in which these are functioning.

Unit 7

Safety Risk Severity

Learning Objectives

By the end of this unit, you will be able to:

- Understand safety risk severity
- Discuss safety risk tolerability rating
- Describe safety risk management documentation

Introduction

The aviation system is dynamic and extensively prone to changes. Thus, SRM tends to be a continuous activity. Due to significant changes, new hazards may come to know. Also, existing hazards change with time. Thus, the safety risk mitigation strategies have to be monitored so that these prove appropriate with types of hazards and also to determine if further action is required.

It is essential to assess the severity of risks with respect to potential consequences related to hazards. The given unit gives comprehensive learning about safety risk severity in the aviation sector.

Safety Risk Severity

After assessing the probability of risks, the next step is to evaluate the severity. Severity can be classified based on two factors:

- Fatalities or serious injuries which would occur as a result of personnel being in the aircraft or having direct contact with any part of the aircraft or jet blast.
- Damage or structural failure of the aircraft or ATC or aerodrome equipment affects the performance of the flight characteristics and requires a major repair of the damaged part or its replacement. The damage could impact the normal functioning of flight operations.

Assessing the severity of the damage should consider all possible aftereffects till the worst that could have happened.

Given below is a table to depict the level of severity. Note that, the table is an example only:

Safety Risk Severity Table – Example		
Severity	**Meaning**	**Value**
Catastrophic	Aircraft equipment destroyed Multiple deaths	A
Hazardous	A large reduction in safety margins, physical distress or workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely Serious injury Major equipment damage	B
Major	A significant reduction in safety margin, a reduction in the ability of operational personnel to cope with adverse conditions as as a result of an increase in workload or as a result of conditions impairing the efficiency Serious Incident Injury to persons	C
Minor	Nuisance Operating limitations Use of emergency procedures Minor incident	D
Negligible	Few consequences	E

Given below is another example of a hazard severity that describes the effect on operations, occupants, aircrew, and air traffic services:

Hazard Severity Classification by EUROCONTROL – An Example					
Hazard Class	**Most Severe**				**Least Severe**
Effect on Operations	Hull Loss. Total loss of flight control, mid-air collision, flight into terrain or high-speed surface movement collision	Large reduction in safety margins or aircraft functional capabilities	Significant reduction in safety margins or aircraft functional capabilities	Slight reduction in safety margins or aircraft functional capabilities	No effect on operational capabilities or safety
Effect on Occupants	Multiple fatalities	Serious or fatal injury to a small number of passengers or crew	Physical distress, possibly including injuries	Physical discomfort	Inconvenience
Effect on Air Crew	Fatalities or incapacitation	Physical distress or excessive workload impairs ability to perform tasks	Physical discomfort, possibly including injuries or increase in workload	Slight increase in workload	No effect on flight crew
Effect on Air Traffic	Total loss of separation (between aircraft)	Large reduction in separation or a total loss of air traffic control for a significant time	Significant reduction in separation or significant reduction in air traffic control capability	A slight reduction in separation or a slight reduction in air traffic control capability. Significant increase in air traffic controller workload	Slight increase in air traffic controller workload

Safety Risk Tolerability Rating

To get the safety risk index rating, the results of probability and severity scores are combined. This is an alphanumeric designator. The respective combinations related to probability and severity are presented in the safety risk assessment matrix. The safety risk of hazard can be obtained from this particular matrix.

An example is given below to explain the same:

Consider a situation where the safety risk probability has been assessed as Frequent (5), the safety risk severity has been assessed as Major (C), the safety risk index of the hazard is (5C)

Table: Safety Risk Matrix

Safety Risk	Severity				
Probability	Catastrophic	Hazardous	Major	Minor	Negligible
	A	B	C	D	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

Note: To determine the safety risk tolerability, consider the quality and reliability of the data used for the hazard identification and safety risk probability

After this, prepare a safety risk tolerability table with the index obtained from the safety risk assessment matrix. This will give a picture of the tolerability level of the hazard.

The tolerability table Safety risks are assessed as acceptable, tolerable, or intolerable. Those safety risks that fall under the category of intolerable are not at all acceptable. The severity of hazards can pose extremely adverse effects and therefore it is advisable to stop activities or take severe mitigation actions.

Table: Example of Safety Risk Tolerability

Safety Risk Index Range	Safety Risk Description	Recommended Action
5A, 5B, 5C, 4A, 4B, 3A	Intolerable	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	Tolerable	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk
3E, 2D, 2E, 1B, 1C, 1D, 1E	Acceptable	Acceptable as is. No further safety risk mitigation is required

As seen, the safety risk index assessed as 5C falls under the intolerable category. This, consequence is highly unacceptable. Efforts need to be taken to minimize the probability component of the risk or lessen the severity component of the risk or both so that a tolerable level is attained.

Safety risks under the tolerable category are acceptable if the organization implements the required mitigation strategies. With the help of these strategies, a risk under the intolerable bracket can be transferred to the tolerable group.

Safety risks under the acceptable category need no action as these are acceptable and the severity of hazards is under control.

Table: Tolerability Description

Tolerability description	Assessed risk index	Suggested criteria
Intolerable region	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
Tolerable region	5D, 5E, 4C, 4D 4E, 3B, 3C, 3D 2A, 2B, 2C, 1A	Acceptable based on risk mitigation. It may require management decision.
Acceptable region	4E, 2D, 2E, 1B 1C, 1D, 1E	Acceptable

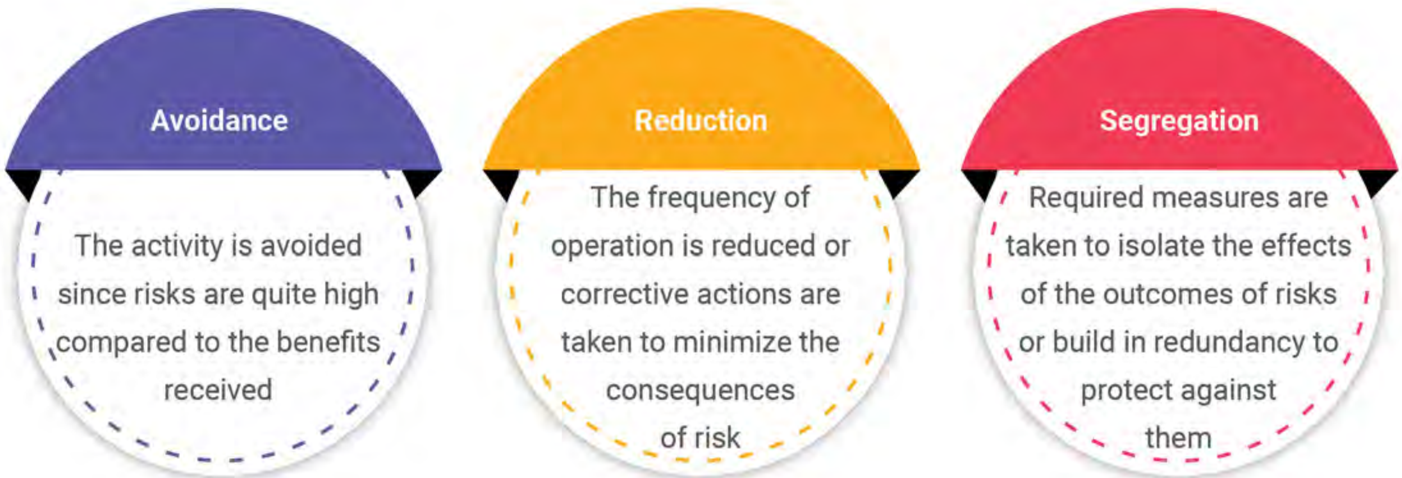
Assessing Human Factors Related Risks

Human factors hold prime importance in SRM. Human beings have limitations and their performance can vary. Thus, they can contribute to accidents or other incidents. At the same time, they can contribute to taking corrective actions to prevent accidents. Thus, it is important to identify, assess and mitigate risks that involve human beings. SRM assesses all aspects of safety risks, and assessing the performance of human factors is quite complex compared to assessing those risk factors that could occur due to technology and environmental issues.

Safety Risk Mitigation Strategies

Safety risk mitigation can also be referred to as safety risk control. Safety risks can be managed through mitigation strategies. These risks need to be balanced against time and cost and by taking steps to reduce their impact. The level of risks can be minimized by reducing the severity of potential aftereffects, reducing the frequency of occurrences, and reducing risk exposure to risks. Reducing severity is a bit difficult, therefore it is advisable to minimize the chances of occurrences.

The categories of safety risk mitigation strategies can be described as:



A mitigation strategy can involve either of the above-mentioned strategies or a combination of these.

It is highly essential to consider human factors while identifying effective mitigations. Human beings have the responsibility for corrective actions. They provide inputs for use of processes for mitigation. In the absence of human expertise, the procedures developed might not work in the correct and required direction.

At the same time, human beings have certain performance limitations. These have to be considered as part of any safety risk mitigation. The human factor perspective results in comprehensive and effective mitigations.

The effectiveness of mitigation strategies needs to be evaluated. The given perspectives can be kept in mind:

- **Effectiveness:** The degree to which the alternatives minimize or eliminate the risks judge the effectiveness. Effectiveness is determined in terms of technical, training, and regulatory defenses.
- **Cost/benefit:** The extent to which acquired benefit exceeds the cost involved
- **Practicality:** The extent to which it is feasible to implement a mitigation strategy and how appropriate is it with respect to the real-world conditions
- **Enforceability:** The extent to which new rules and regulations can be enforced
- **Durability:** The extent to which the strategy would prove effective and sustainable
- **Residual safety risks:** The extent of risks that are subsequent to the implementation of mitigation strategy initially, and the need for additional safety measures
- **Unintended consequences:** Any new hazard that arises as a consequence of the implementation of the strategy
- **Time:** Time required for the implementation of the safety risk mitigation alternative

Corrective measures should consider current defenses and the ability or inability to attain an acceptable level of safety risks. It is advisable to assess the impact of any corrective action/s that has been taken previously. Verification of safety risk mitigation strategies has to be done to ensure their effectiveness. Another way to monitor the effectiveness of mitigations is through the use of Safety Performance Indicators.

Safety Risk Management Documentation Using Hazard Register

It is important to clearly document the safety risk management activities, including any assumptions being made. This can be done with the help of available databases or software. A large amount of safety data and safety information can be stored and can be assessed as required.

If a documented register is maintained about hazards identified, it helps organizations to make a comparison if a hazard is new or has already taken place before. In case any previous hazard is identified, the actions taken previously can be assessed. Hazard registers typically include:

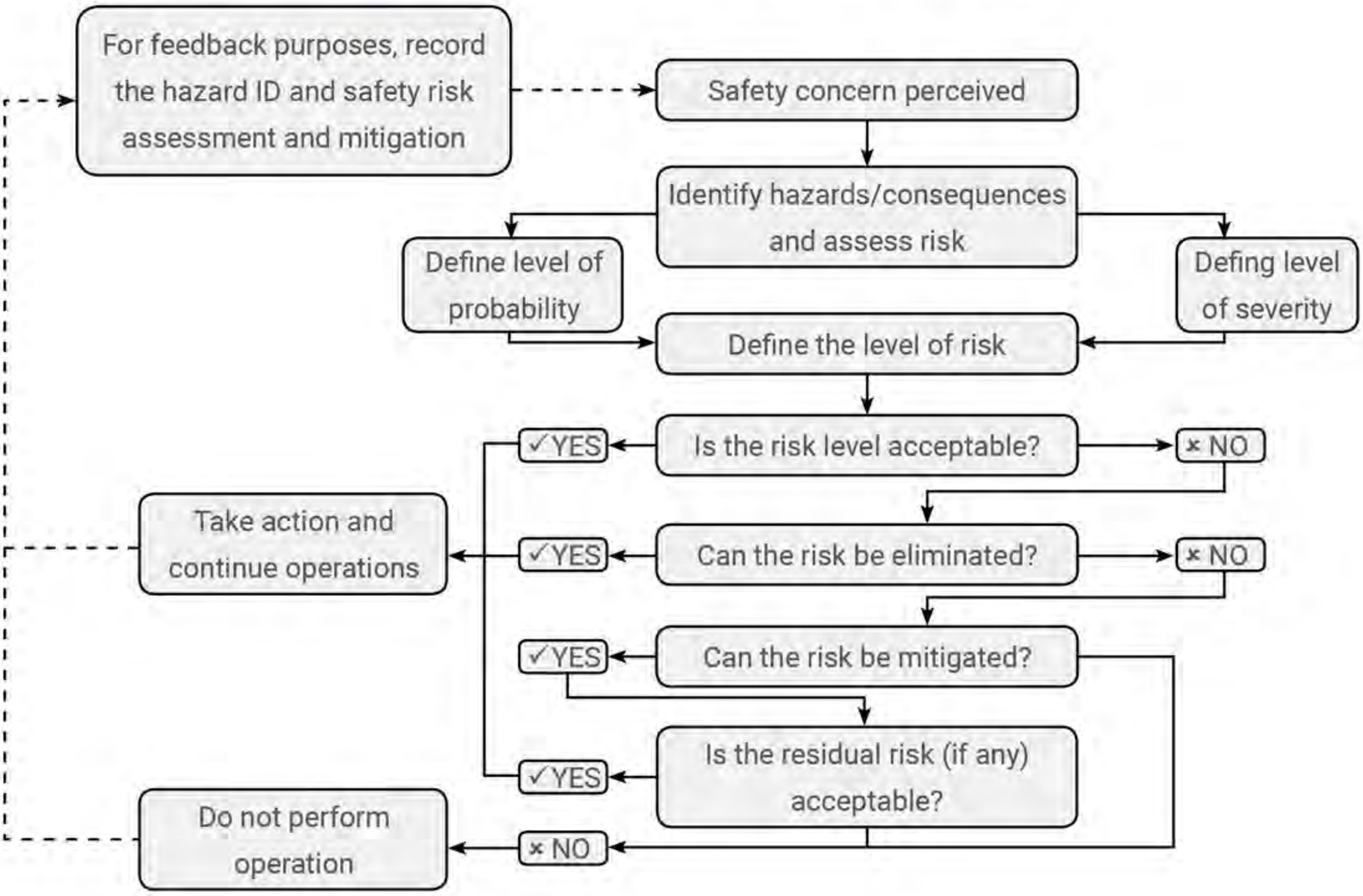
- The hazard and category of hazard
- Potential Consequences
- Assessment of associated risks
- Identification date
- Short description of when or where it applies, who identified it, and what measures have been put in place to mitigate the risks

Cost-benefit Analysis

This analysis is carried out during safety risk mitigation activities as a component of business management. It is commonly associated with regulatory impact assessment or project management processes and even has a significant financial impact.

A cost-benefit analysis supports safety risk assessment. It ensures justification of the actions recommended for risk management taking financial aspects under consideration.

Figure: Safety Risk Management Decision Aid Flow Chart



Summary

Safety risk management is an essential component of safety management. It includes the identification of hazards, assessment of safety risks, mitigation of safety risks, and risk acceptance. It is important to identify hazards so that corrective measures can be taken. After assessing the probability of risks, the next step is to evaluate the severity. Safety risk mitigation can also be referred to as safety risk control. Safety risks can be managed through mitigation strategies. Safety risks should be managed to an acceptable level by mitigating the safety risk through the application of appropriate safety risk controls.

Unit 8

High-Risk Categories of Safety Occurrence and Mitigating Measures

Learning Objectives

By the end of this unit, you will be able to:

- Describe various high-risk categories of safety occurrences and their mitigating measures

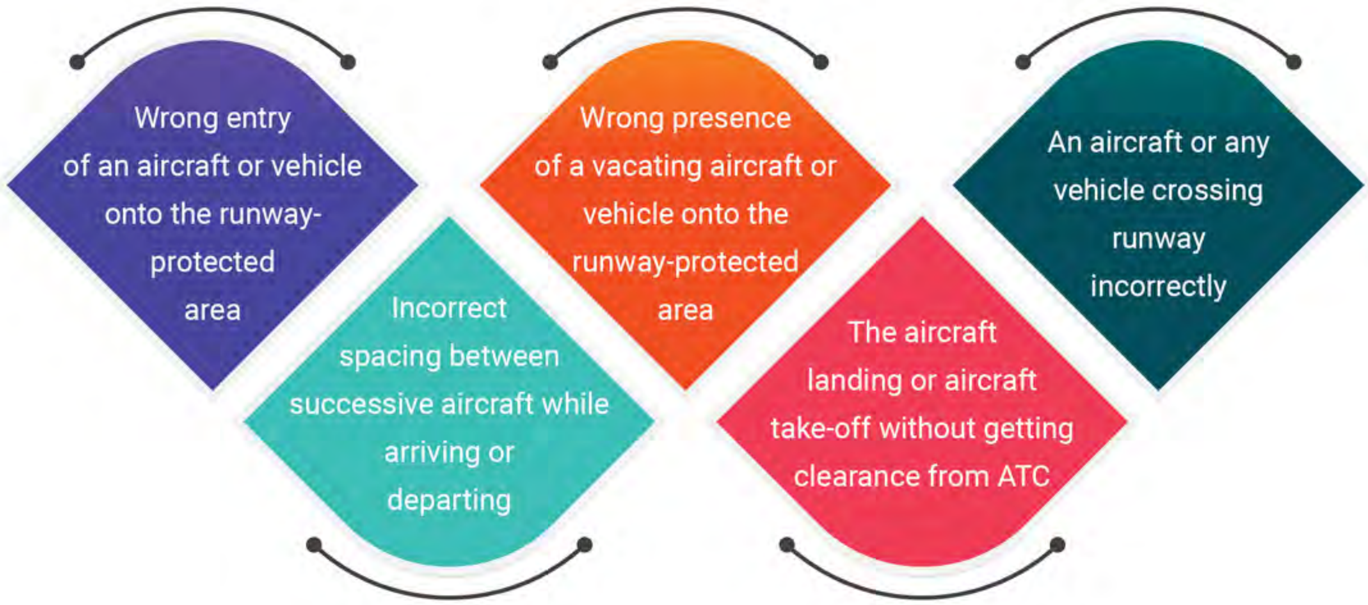
Introduction

ICAO identifies three High-Risk Accident Categories Viz. Runway Safety (RS) related events, Loss of Control In-Flight (LOC-I), and Controlled Flight into Terrain (CFIT). Runway safety events include runway safety abnormal runway contact, runway excursion, runway incursion, loss of control on the ground, ground collision, collision with obstacles, and undershoot/overshoot.

Runway Incursions

Any incorrect presence of an aircraft and/or any other vehicle and/or any human in a protected area designated for the landing and/or take-off activity of an aircraft is runway incursion.

Types of runway incursions



Common reasons for incursions are triggered by air traffic controllers, flight crew, or vehicle drivers.

Categories of runway incursions:

The categories are based on the severity of incursion and can be explained as:

Highest Severity Category: The highest severity category is an accident, for instance, a collision due to an incursion.

Category A: There is no collision, but a serious incident when a collision nearly got avoided

Category B: Incidents when separation decreases and there is a chance for collision, which may result in an evasive response to avoid a collision

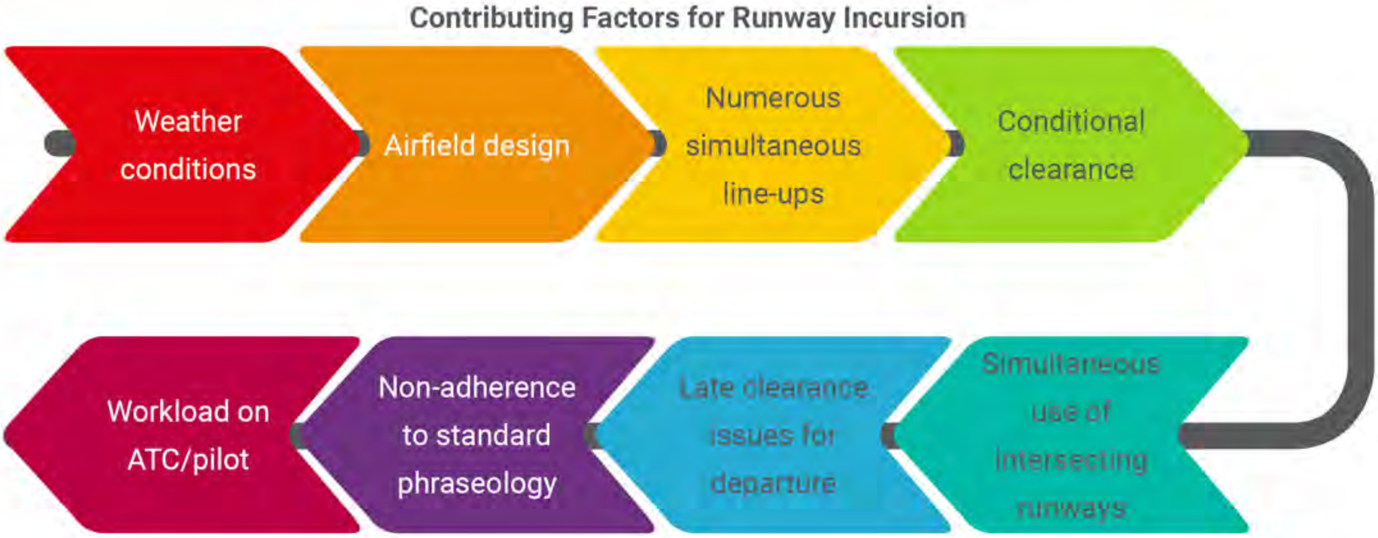
Category C: An incident when ample time is there to avoid a collision

Category D: It is the lowest severity category. An example is when a person/vehicle is wrongly present in a protected area designated for landing/take-off of aircraft but with no immediate safety consequences

The extent of severity depends upon the available reaction time, evasive corrective action, environmental conditions, speed of the aircraft/vehicle, and proximity of the aircraft/vehicle.

Measures to Minimize the Incursion

To prohibit entry to the runway from the taxiway, there is a provision for 'runway guard lights' and 'stop bar lights. The pilot or the driver of a vehicle must stop or wait at the runway holding position until he/she obtains clearance from the ATC to enter



the runway. The holding position is also marked on the taxiway pavement.

In the year 2016, ICAO introduced the autonomous runway incursion warning system (ARIWS). The purpose was to enable an autonomous detection of potential incursions or occupancy of an active runway using a direct warning to a flight crew or vehicle operator so that the frequency of runway incursions and the related consequences are minimized.

The Runway Status Lights (RWSL) have been developed to deliver automatic warnings and runway status indications to pilots and vehicle drivers in the area.

ARIWS uses a surveillance system to monitor the actual situation on a runway. The information generated automatically gets delivered to warning lights at the runway entrances and thresholds.

- When an aircraft departs or arrives at a runway, red warning lights at the entrances illuminate.

This is a signal that it is unsafe to enter or cross the runway.

- When an aircraft is aligned on the runway for take-off and any other aircraft or vehicle enters or crosses the runway, the illumination of red lights is an indication that it is not safe to start the take-off roll.
- When ARIWS lights trigger, it is a globally accepted indication for pilots and drivers to "STOP IMMEDIATELY".

Surface Indications and Alert System (SURF) is designed so that pilots can avoid collisions. The credit for developing SURF goes to Honeywell Aerospace under a Single European Sky ATM Research (SESAR) research program in partnership with Airbus, Dassault, and Euro-control. The software uses a combination of ADS-B, algorithms, and flight data analysis. This helps pilots to get visual as well as audio warnings about any hazard on the runway. However, it is just an alert, the ultimate decision has to be taken by the pilot as to how to deal with the situation. SURF covers both runways and cross-runways.

Runway Incursion Example

The first officer of an airline company was suspended for three months by the DGCA since the respective officer misheard the clearance given by ATC. As a result, incorrect directions were given to the pilot-in-command (PIC) which caused a runway incursion at Mumbai airport. The two aircraft involved in the incident had similar call signs.

DGCA suspended two pilots for not paying attention to the instructions given by ATC which led to an accident. Flight A320 had to take off and did not adhere to the instructions given by Surface Movement Control (SMC) to wait at holding point "A" at RWY. However, the pilot did not hold and an incursion took place.

Runway Excursion

ICAO defines a runway incursion as: "A veer off or overrun off the runway surface".

An aircraft may not stay on the runway payment during take-off or landing. It might move to the side of the runway or beyond the runway end. This leads to a runway excursion which might be intentional or unintentional on the part of the pilot.

Types of runway excursions can be explained as:

- A departing aircraft fails to become airborne or successfully rejects the take-off before reaching the end of the designated runway.
- A landing aircraft is unable to stop before the end of the designated runway is reached.
- An aircraft taking off, rejecting take-off or landing departs the side of the designated runway

Consequences of Runway Excursion

- Death or injury to persons on board the aircraft or not on board but on the ground.

- Damage to the aircraft, which had runway excursion, and may also damage other aircraft or vehicles.
- Damage to the airfield, for example, damage to runway lights.
- Airport operation may get affected by either total closure for airports with a single runway or partial or affects capacity if there are multiple runways in the airport. Such impact will continue till the aircraft is removed from that location to the bay, as the aircraft, which had runway excursion may obstruct the use of that runway. Removal of such aircraft may take several hours.

Approach and Landing Accident Risks are attributed to Unstable approaches, undesired airplane state, failure to go around, weather, runway conditions, and late runway changes. IATA Risk Mitigation publications, Enhanced Training, Landing distance assessment, Go- Around training, and alerting systems are some of the mitigating measures. Software upgrade to Enhanced Ground Proximity Warning System (EGPWS) alerts crews to an unstable approach condition regardless of runway length allowing them to address instability before a go-around becomes necessary. It also alerts the crew with possible landing beyond the Touch Down Zone (TDZ) regardless of available runway length, when crews have little or no visual reference to identifying the end of TDZ.

Unstable approaches and go-arounds can be avoided thus improving schedule integrity and blocking time variability with the following solutions, using runway information from the EPGWS:

- Runway Awareness and Advisory System (RAAS) from Airbus, Boeing, or Honeywell.
- Honeywell SmartRunway/SmartLanding- includes stabilized approach monitor.
- Airbus Runway Overrun Prevention System (ROPS).
- Boeing Runway Situational Awareness Tools (RSAT).

Airbus/NAVBLUE Landing Surveillance (A is a

combination of ROPS and SmartLanding)

Illustration of Runway Excursion Serious Incident

Incident 1:

An Airbus A320 commercial jet was forced to take a dangerous take-off from Bengaluru International Airport in adverse and unfavorable weather conditions. This forced DGCA to set up an inquiry. The flight took off from Nagpur with 180passengers on board and was scheduled to arrive in Bengaluru later the same day. However, the plane began veering off the runway and onto the grass-covered strip of land on one side of the runway. The pilot increased the speed and was lucky to take off on time thus saving the passengers.

Incident 2:

A heavy storm hit Mumbai, making things extremely difficult for ATC and other airport officials, ultimately leading to a runway excursion. 5 go-arounds took place and the airport had to close its operations for nearly 40 minutes. A flight performed a rather standard approach and landing sequence. On the final approach to the runway, the aircraft touched down extremely beyond the touchdown zone. The visibility was very less and due to extremely harsh winds, the aircraft overshot the runway causing

the nose wheel and the main landing gear wheels to sink into the mud/grass field at the end of the runway. The aircraft came to a stop and fortunately, no casualties were reported. The aircraft suffered substantial damage and the runway got blocked till the aircraft was towed away.

Mid-Air Collision (MAC): MAC is a category of accidents in aviation that is rare but usually catastrophic that can result in the deaths of passengers and crew members since the collision is in mid-air. We have many examples, one prominent being the mid-air collision of two aircraft over Chakri- Dadri air space near Delhi in 1996, killing all the passengers and crew members.

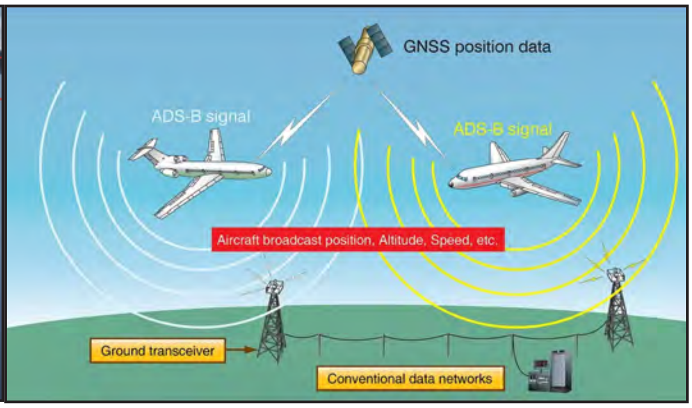
'Near mis' incidents are precursors for mid-air Collision. A near miss is when two aircraft come so close that their safety is compromised. The safe distance between two planes flying in opposite directions is 40 seconds depending on their speed. Similarly, a vertical distance of 1,000 feet is considered safe. Such incidents are classified as serious incidents, showing an increasing trend due to air space congestion and no-fly air space reserved for military aircraft. The average number of such incidents in India is 1.3 per 100,000 per landing & take-off flights, which is less than when compared with a global average of 4.43, but still, it

serious issue. The reasons for such incidents could be either due to air traffic controllers (attributable to workload or other reasons) or pilots misunderstanding or not following strictly ATCO instructions. ICAO has included MIC as High-risk Category in 2019 since such incidents are serious and may result in an accident and if that happens the fatality would be very high.

Airborne Collision Avoidance System (ACAS) or Traffic collision avoidance system (TCAS) is an air-to-air communication system that gives audio-visual warnings in the cockpit in the event of a potential danger being faced in the form of a conflicting aircraft dangerously coming in proximity.

ACAS is found to be very useful equipment for the pilot as it immediately issues alert warnings for the avoidance of collision. ACAS provides avoidance protection & air space situational awareness for the aircraft.

ACAS advises pilots to avoid potential collisions. This is done through resolution advisories (RAs), which recommend actions, and through traffic advisories (TAs). The intention is to prompt visual acquisition and act as a precursor to Ras. ACAS provides a backup collision avoidance service to the existing ATC system. ACAS does not depend upon any ground-based systems.



There are three types of ACAS:

01 **ACAS I** issues warning known as traffic advisories (TA) but does not provide Resolution Advisories (RA).

02 **ACAS II** provides vertical Resolution Advisories (RA) in addition to TA, but not the horizontal resolution advisory.

03 **ACAS III provides vertical as well as horizontal Resolution Advisories in addition to Traffic Advisories.**

A real example:

Two planes in X airspace were only 250 meters apart. This depicts a very high chance of collision. However, TCAS acted well on time and diverted these to safe distances thus preventing a serious accident.

Controlled Flight into Terrain (CFIT)

IATA describes CFIT, which includes all instances where the aircraft was flown into terrain in a controlled manner, regardless of the crew's situational awareness. CFIT does not include undershoots, overshoots, or collisions with obstacles on take-off and landing, which are included in Runway Safety.

During the last few years, CFIT accidents represent merely 3% of all commercial accidents, however, this is still the second-highest fatal accident category after LOC-I. CFIT is a result of a lack of awareness, a lack of TAWS (Terrain Avoidance

Warning System) or EGPW (Enhanced Ground Proximity Warning System), an outdated software system, or the absence of GPS.

TAWS or GPWS is a system that provides adequate information to the crew members. The system can alert about a hazardous terrain situation thus enabling crew members to take corrective measures. It is a safety net that automatically warns pilots when an airplane is in dangerous proximity to terrain.

The first implementation of TAWS was Ground Proximity Warning System (GPWS). It got introduced in the 1970s. Many countries made this basic GPWS mandatory and saw a significant decline in CFIT accidents. However, a major limitation of the system was its dependency on the radio altimeter to measure proximity to terrain. This allowed little time to avoid a sudden change in terrain in the form of steeply rising ground. Gradually, improvements were added to the airplane configuration.

Honeywell Enhanced Ground Proximity Warning System (EGPWS) relates to aircraft position. It should be from a GPS source internal to eth equipment or fed from the aircraft FMS, to an almost

worldwide terrain/obstacle/airport database which the equipment manufacturer regularly updates. A comprehensive set of alerts can be generated using a radio altimeter and relative position.

Loss of Control-In-flight (LOC-I)

IATA's definition is 'Loss of control in-flight that is not recoverable. During the last few years, the LOC-I category marked 8% of all accidents. However, it represented the highest percentage of fatal accidents. LOC-I happens due to the lack of airplane energy state awareness and or airplane system state, and also airplane system malfunctioning. Mitigations for LOC-I are IATA Training guidance, enhanced CRM training and Go-Around Training.

IATA's Six-Point Strategy

It presents a complete view of identifying operational and organizational safety issues. The key pillars of the strategy include:

- Improved technology
- Regulatory harmonization
- Training
- Awareness


A reduction in operational risk
Increase quality and compliance
Identify and address emerging safety issues
The six safety strategies are:
Promote improved aviation infrastructure
Promote effective recruitment and training
Support consistent implementation of Safety Management Systems (SMS)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Each of these six key areas breaks down into several subcategories which address specific aspects of the strategy. For example, the subcategories for the first strategy -reduction in operational risk are CFIT, manual handling skills, LOC-I, Mid Air Collision, runway safety, IATA MET Project, ground operations safety, and fatigue management.

Summary

ICAO identifies three High-Risk Accident Categories Viz. Runway Safety (RS) related events, Loss of Control In-Flight (LOC-I), and Controlled Flight into Terrain (CFIT). Runway Guard lights and Stop Bar lights are provided at the runway holding positions to caution entry to the runway from the taxiway and the pilot/vehicle driver must hold/stop at the runway holding position and is mandated to get clearance from the air traffic controller before entering the runway. IATA's safety strategy is a holistic approach to identifying organizational and operational safety issues.

Unit 9

Aviation Safety and Human Factors

Learning Objectives

By the end of this unit, you will be able to:

- Understand the four approaches in aviation safety
- Describe SHELL model
- Discuss practical drift

Introduction

Safety is defined as "The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level". It is important to note that acceptable safety performance is often defined and influenced by domestic and international norms and culture.

Aviation Safety

As we know, hazards in the aviation sector are unavoidable and continuously emerge. This makes this sector dynamic. The aviation sector can be kept safe if hazards can be identified well on time and necessary corrective measures can be adopted. It is important to keep safety risks under control at an appropriate level.

Progress in aviation safety is described by four approaches:

Technical approach: As per this approach, the focus is on the improvement of technical factors. If technological improvements are made, the frequency of accidents will reduce. This approach and focus on technical aspects were of prime importance till 1960.

Human Factor Approach: As per this approach, the focus shifted toward human beings involved in the aviation sector contributing to safety risks and mitigations. With advancements in technology, the risks involved due to technical aspects were reduced. The focus on human factors includes the man/machine interface. It was seen that frequent human errors for example pilot errors contributed as a recurring factor in accidents.

Organizational Approach: In this approach, the focus is on organizational factors as well apart from human and technical factors. The idea of an "organizational accident" got introduced which laid emphasis on organizational culture and policies that affect safety risk controls.

Additionally, reactive and proactive methodologies facilitated the collection of routine safety data that further enabled organizations to monitor known safety risks and detect emerging safety trends. All these factors helped in developing the current safety management approach.

Examples of Organizational Accidents

- Employees develop workarounds instead of following procedures
- Organization does not learn from prior events and precursors
- Senior management is focused on finances and customer service
- Organization uses the wrong safety metrics to gauge the safety
- Regulatory oversight is not sufficient

Total System Approach: This approach considers the aviation system as a whole particularly interfacing and coordination with other organizations/service providers operating in the system. States and service providers have now implemented SSP

and SMS which have contributed to a higher level of safety maturity. Yet, the prime focus still rests on safety performance and control within the organization.

A lack of interfaces between service providers/ organizations leads to negative outcomes. This can be seen from the investigation of accidents and unfavorable incidents.

The need for safety has led to an interaction between service providers and other components of the system. It has also been realized that an effective collaboration between service providers and States helps in the generation of favorable outcomes.

Human Factor and Safety Management

If senior management and other people in the organization depict active involvement toward achieving safety parameters, safety performance can be enhanced. It is important to understand the capabilities and limitations of people working in a system and how they interact with each other. The human factor is a crucial component of the

safety management system and it is necessary to understand, identify and mitigate risks as well as to optimize the human contributions to organizational safety.

Few of the ways through which the safety management processes consider human factors are:

- There has to be a common understanding between staff members and they must be clear about their responsibilities to the safety management
- Commitment and willingness of senior management to encourage staff members to actively participate in the safety management processes
- Awareness of organizational processes and procedures
- Availability of sufficient manpower to meet the operational requirement to adhere to the processes
- Establishment of policies and procedures to encourage safety reporting
- Analysis of safety data and safety information
- Clearly defined policies and procedures need to be developed. The aim should be to optimize human performance, minimize unwanted outcomes and prevent unintentional errors

Ongoing monitoring of normal operations helps in evaluating if procedures are being followed or not and if not then identifying the reasons for the same.

At the same time, imparting training to the staff makes them competent to perform their duties. When these training programs are evaluated, it helps to understand the changing needs. The management has to create an organizational culture that addresses the right working environment and safety culture. This will also influence the attitudes and behaviors of everyone in the organization.

SHELL Model (For the Assessment of Human Factors on Safety Performance)

SHELL, where S stands for Software, H for Hardware, E for Environment, and L for Liveware.

The SHELL model is quite useful to depict the impact and interaction of the different system components on humans and between humans. This model clearly depicts the importance of the human factor in Safety Risk Management (SRM).

The humans are depicted at the core of the model. They are responsible for front-line operations. Among all other components, the human factor is the most unpredictable and most susceptible to various external and internal factors such as fatigue, temperature, noise, motivation levels, etc.

There is no doubt that humans are remarkably adaptable, they are prone to variations in performance. The degree of performance is not standardized as in the case of hardware. Therefore, other components of the SHELL model must be adapted to be in conformity with the human factor.

Components of the SHELL Model

Software (S)

- Non-physical and intangible aspects of the aviation system. It is the operating software of the system which governs the operations of the system and also how the information within the

system is organized.

- Includes rules, checklists, instructions, regulations, policies, norms, laws, orders, safety procedures, standard operating procedures, customs, practices, conventions, habits, symbology, supervisor commands
- Includes recency of experience, accuracy, format and presentation, vocabulary, and clarity
- Includes documents, obstacle charts, grid maps, Aeronautical Information Publications, emergency operating manuals, and procedural checklists

Hardware (H)

Physical elements include controls and displays in the cockpit, avionics systems and seating, tools, buildings, motor transport, IT servers, screening machines, passenger boarding bridges, etc.

Environment (E)

- The physical, organizational, economic, regulatory, political, and social variables creating an impact on the workers and operators
- The internal air transport environment includes physical factors such as cabin/cockpit temperature, air pressure, humidity, noise, vibration, and ambient light levels
- The external air transport environment includes the physical environment outside the work area such as weather conditions, terrains, airspace, airport infrastructure, and other organizational, economic, regulatory, political, and social factors

Liveware (L)

This comprises the human factor. The crew members, flight operators, Air traffic controllers, ground handling personnel, management, and

administration personnel, etc. The liveware component considers human performance, capabilities, and limitations.

The four components of the model act in collaboration, and each component interacts with the human component. The model optimizes the relationship between people and their activities within the aviation system which is of primary concern to human factors.

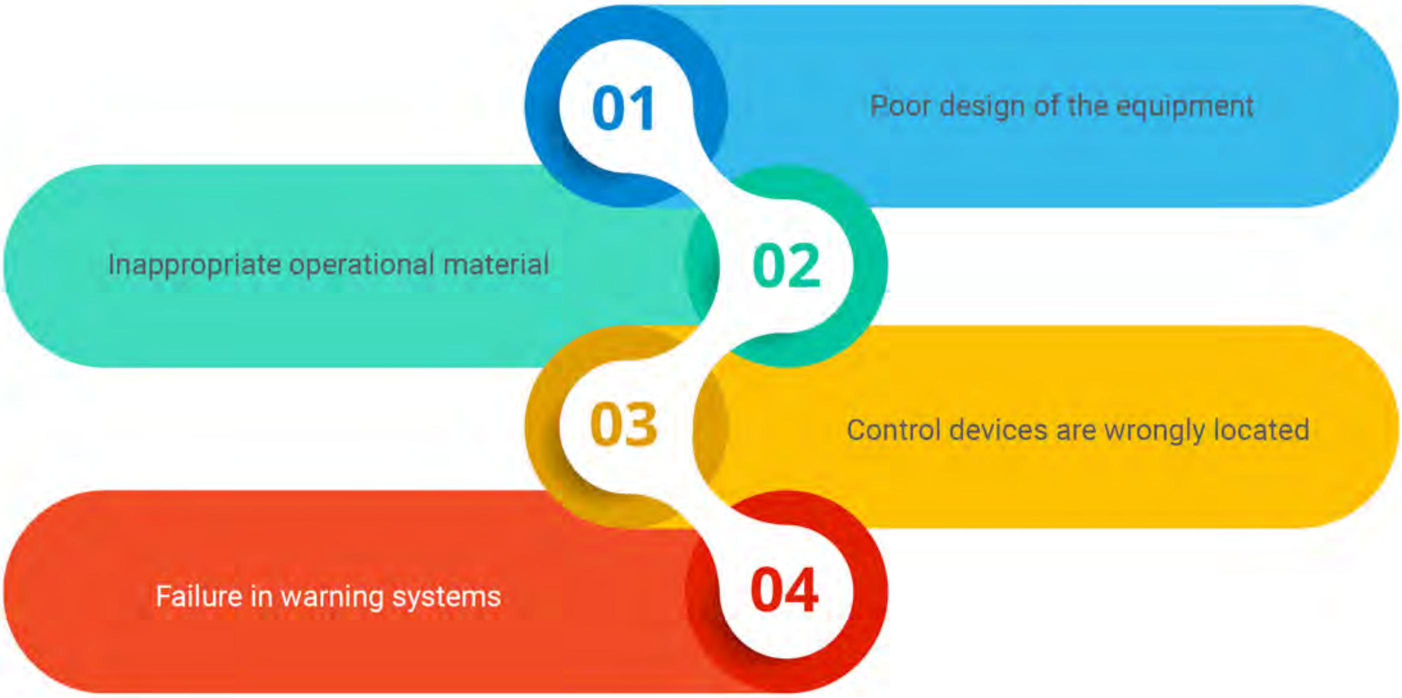
ICAO describes the interaction of human factors with machines (hardware), procedures (software), and the environment, as well as their interpersonal relationships.

According to the SHELL model, an aviation disaster can occur if there is a mismatch at interfaces between system components, rather than terrible failures of individual components. Let us try to understand the interfaces between the various components of the aviation system described in the SHELL model:

Liveware–Hardware

- Interaction between human operator and machine.
- Involves matching the physical features of the aircraft, cockpit, or equipment with the general characteristics of human users, for instance, designing crew seats so that passengers can fit in comfortably, or designing cockpit displays and controls to match the sensory and movement characteristics of human users.

There can be mismatches in the L-H interface due to:



Liveware-Software

- Interaction between the human operator and non-physical supporting systems in the workplace
- Involves designing software to match the general characteristics of human users and ensuring that the software can be implemented with ease
- The crew members usually incorporate procedural information given during training into their memory. Any further information can be obtained from available manuals, checklists, maps, and charts.

There can be mismatches in the L-S interface due to:

- Inappropriate procedures that can lead to delayed actions
- Ambiguous checklists that can cause misinterpretation
- Misleading and cluttered documents, maps, or charts
- Lack of rationality in indexing of operations. This can take time to locate a particular operational procedure during an emergency.

Liveware-Environment

- Interaction between the human operator and internal and external environments
- The environment must match human requirements, for instance, there must be a sound-proofing system, the air conditioning system should be such that it maintains an ideal cabin temperature, and so on
- The internal workplace environment includes such physical considerations as temperature,

humidity, etc. and the external environment includes operational aspects such as weather factors, aviation infrastructure, and terrain

- The aviation work environment includes disturbances to normal biological rhythms and sleeps patterns
- Additional environmental aspects may be related to organizational attributes that may affect decision-making

There can be mismatches in the L-E interface due to:

- Errors due to disturbed biological rhythms as a result of long-range flying
- Visual illusions during aircraft approach/landing at night time
- Flaws in the performance of the operator
- Failure of the management to address issues due to airline competition and pressure on cutting costs
- Unhealthy organizational environment leading to low employee morale

Liveware-Liveware

- Interaction between the central human operator and any other person in the aviation system during the performance of tasks
- Interrelationships exist among individuals within groups, for instance, between maintenance personnel, engineers, designers, ground crew, flight crew, cabin crew, operations personnel, air traffic controllers, etc.
- The relationships between individuals can influence behavior and performance. Thus, L-L is largely concerned with interpersonal relations, leadership, cooperation, social interactions, and teamwork.
- L-L interface is extremely important as it contributes to the development of cockpit/ crew resource management (CRM) programs, air traffic services (ATS), and maintenance operations. This helps to reduce errors at the interface between aviation professionals.

There can be mismatches in the L-L interface due to:

- Poor communication. A big example of an aviation accident due to lack of communication is the double Boeing 747 disaster at Tenerife Airport in 1977.
- Lack of coordination and balance between aircraft captain and first officer

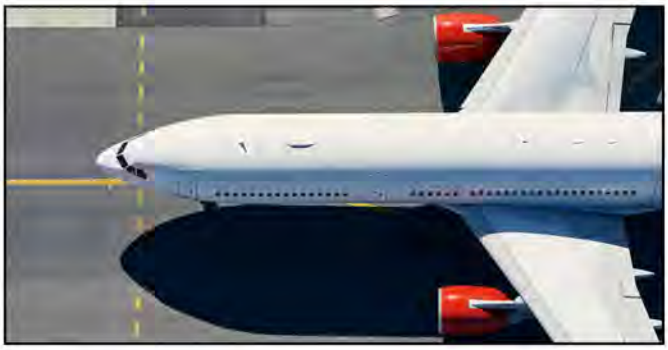
The SHELL model does not consider interfaces that are outside the scope of human factors. Thus, the H-H interface, H-E interface, and H-S interface are not considered as these interfaces do not involve the liveware component.

What Causes an Accident and how to Minimize

One of the most known models in the aviation sector is the "Swiss-Cheese" (or Reason) model, developed by Professor James Reason. The model

illustrates that accidents involve several breaches of defenses that are triggered by numerous factors like failure of equipment or any error in operations.

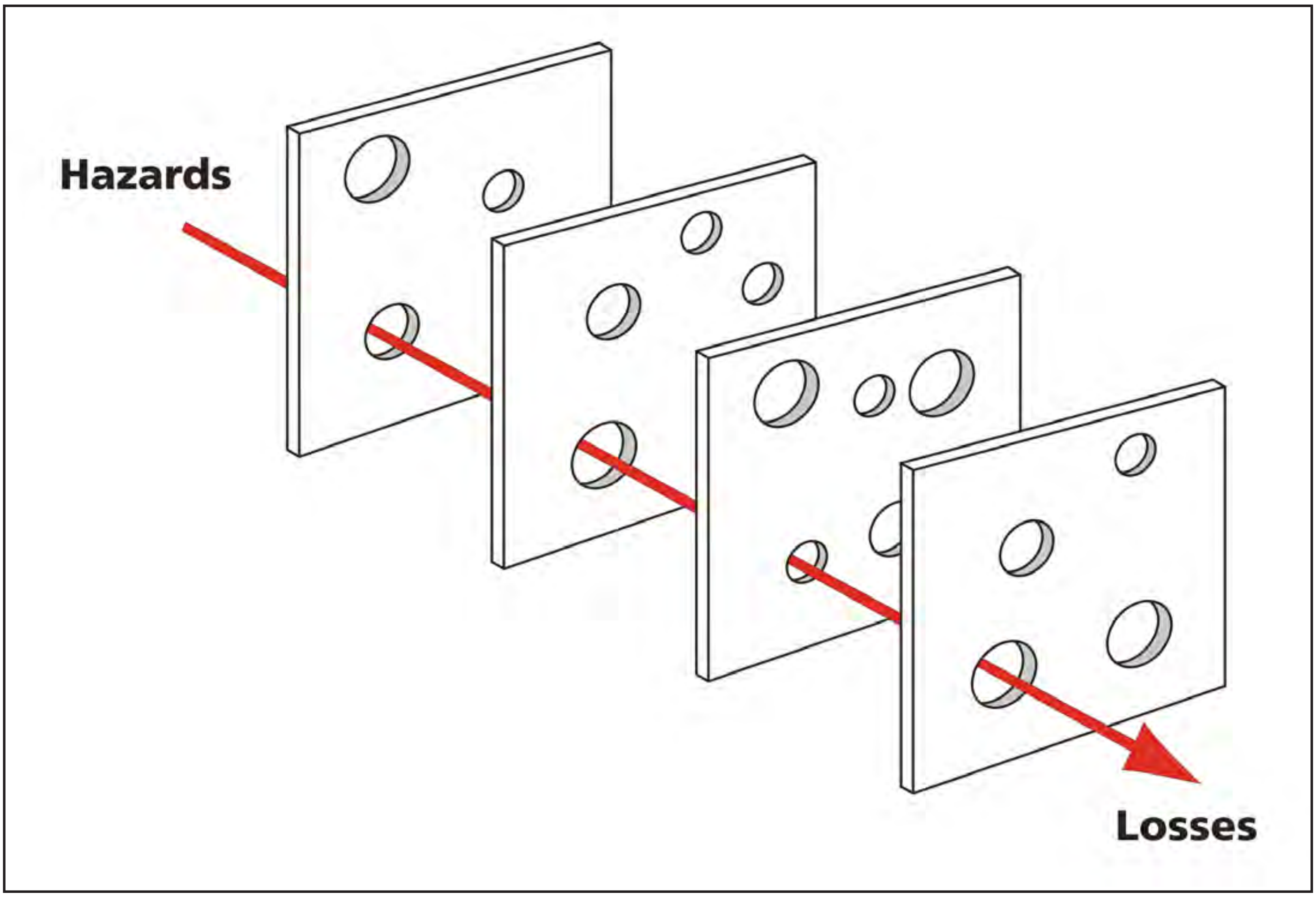
The model advocates that a single-point failure is very rare, rather accidents include a combination of both active failures and latent conditions. Active failures have an immediate adverse effect. They are associated with front-line staff which includes pilots, air traffic controllers, aircraft maintenance engineers, etc. Talking about latent conditions, these persist in the system much before any undesirable event has taken place. Such conditions are not perceived as harmful but can create mishaps under certain conditions. These conditions might arise due to safety culture, equipment choices or procedural design, conflicting organizational goals, defective organizational systems, or management



decisions.

The "organizational accident" paradigm identifies these latent conditions on a system-wide basis. The objective is to reduce active failures.

The Swiss-Cheese model as shown in the figure assists in understanding the interplay of organizational and managerial factors in accident causation.



To protect the aviation system against variations in human performance, many defensive layers are built. However, each layer has certain loopholes as depicted by holes in the slices of "Swiss Cheese". Sometimes, these weaknesses or loopholes align which leads to penetration in defensive barriers and cause an unwanted and harmful outcome. Some defenses or breaches are influenced by an interfacing organization; therefore, service providers must assess and manage these interfaces.

The Swiss-Cheese model represents how latent conditions are ever present within the system and can manifest through local trigger factors.

"Swiss–Cheese" Applications for Safety Management

The Swiss-Cheese model is used as an analysis guide for service providers as well as the States. Evaluation can be done by looking into past events and identifying the individuals involved. This analysis can be applied during SRM, safety surveillance, internal auditing, change management, and safety investigation.

The model also identifies the effective defenses and areas where the system could benefit from additional defenses. The weaknesses in the defenses can be strengthened against future accidents and incidents.

Practical Drift

The theory of practical grift given by Scott A. Snook tries to understand how the performance of any system "drifts away" from its original design. Initially, tasks, equipment, and procedures are framed and designed under ideal conditions. It is assumed that things will go smoothly under controlled conditions, and things will function as desired.

The three fundamental assumptions are:

- Technology is available as per the requirement
- Enough training is given to the staff members to operate the technology as intended
- Policy and procedures will dictate system and human behavior

These assumptions act as a baseline for ideal performance. This is graphically represented as a straight line from the start of operational deployment:

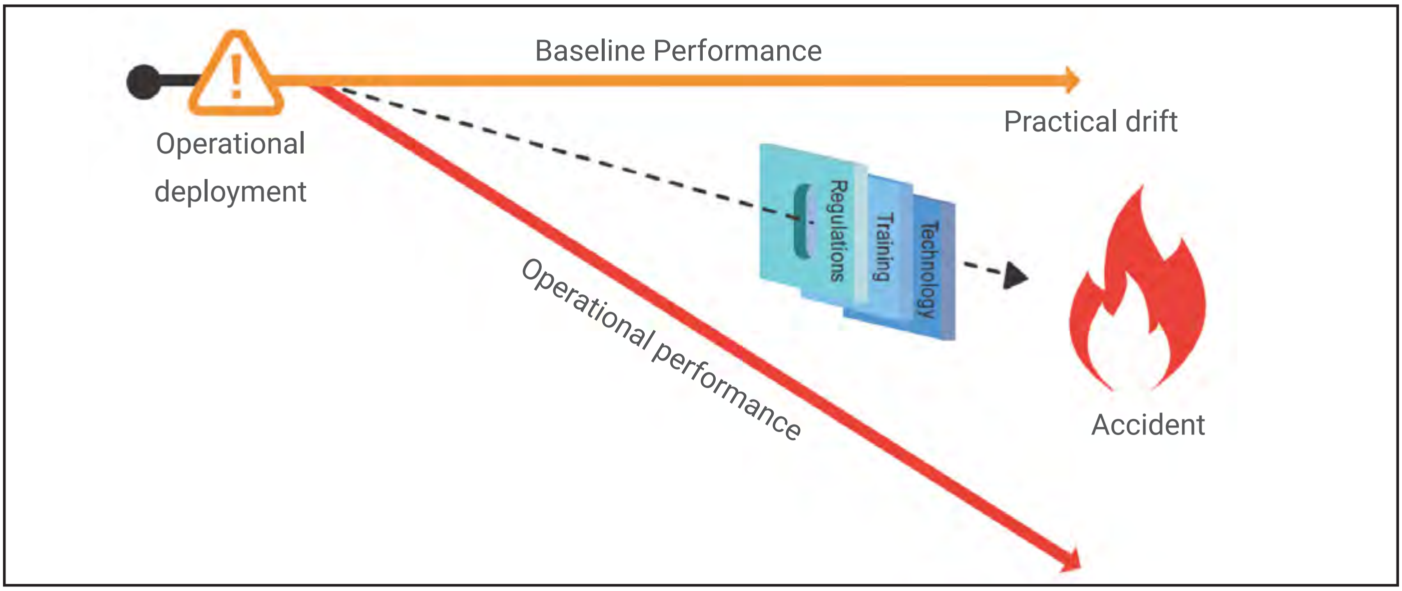


Figure: The Baseline (or Ideal) System Performance

In case of ideal performance, the system should perform as per deployment. However, in a real-world situation, the operational performance often differs from the assumed baseline performance due to complexities in a dynamic environment. The drift is referred to as "practical drift" since it is an outcome of daily practice. The term drift expresses the deviation from the desired course due to external influences.

Snook believes that practical drift is unavoidable, even if one is extremely careful about framing the design. Some possible reasons for the same could be:

- Technology does not operate as predicted
- Procedures that cannot be executed as planned under certain operational conditions
- Changes to the system, including the additional components
- Interactions with other systems
- Safety culture
- Adequacy or inadequacy of resources

In reality, people adapt to shortcomings and apply local adaptations to make a system work. Safety assurance activities like audits, monitoring of SPIs, and observations help to identify activities that are drifting. Once the reason for drift is analyzed, it helps to mitigate the safety risks. It is easier for organizations to intervene if the practical drift is identified as soon as possible. Thus, continuous monitoring is essential.

Protection vs Production

Production/profitability and safety risks/protection are interlinked in organizations engaged in the delivery of services. Profitability is very important for

firms to sustain. At the same time, an organization has to balance output with acceptable safety risks. Typical safety risk controls include technology, training, processes, and procedures.

Safety risk controls include training activities, appropriate use of technology, etc. Implementing these safety control risks involves time, money, and resources. The aim is to improve safety performance, and not production performance. However, investments in protection also contribute to improvement in production to some extent.

Safety space is a metaphor where an organization balances desired production/profitability while maintaining required safety protection through safety risk controls. A balance has to be created in the allocation of resources that does not hamper either production or protection. Allocation of resources towards production must not be at the expense of protection. Likewise, the allocation of excessive resources towards safety risk controls should not prove unprofitable for the firm. A safety boundary has to be defined that provides early warning that an unbalanced allocation of resources exists, or is developing.

The financial management system of firms assesses if firms are heading towards bankruptcy and apply the same logic and tools used by safety management to monitor their safety performance.

This enables the organization to operate profitably and safely within safety space. Therefore, continuous monitoring is required to manage safety space. Organizations have understood the need to balance profitability and safety. This equally applies to the State's management of safety as well.

Summary

- Safety is defined as "The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level". Progress in aviation safety is described by four approaches - Technical, Human factors, Organizational and Total system. If senior management and other people in the organization depict active involvement toward achieving safety parameters, safety performance can be enhanced.
- The SHELL model is quite useful to depict the impact and interaction of the different system components on humans and between humans. This model clearly depicts the importance of the human factor in Safety Risk Management. The SHELL model does not consider interfaces that are outside the scope of human factors.
- The theory of practical grift given by Scott A. Snook tries to understand how the performance of any system "drifts away" from its original design.
- One of the most known models in the aviation sector is the "Swiss-Cheese" (or Reason) model, developed by Professor James Reason. The model illustrates that accidents involve several breaches of defenses that are triggered by numerous factors like failure of equipment or any error in operations.

Unit 10

Preparedness to Deal with Safety/ Security Occurrences

Learning Objectives

By the end of this unit, you will be able to:

- Describe aerodrome emergency planning
- Examine Aircraft Rescue and Fire Fighting (ARFF) services

Introduction

An emergency can be efficiently dealt only with the cooperation and coordination with not only all the aviation stakeholders but also local administration, surrounding community, law and order agency, local fire services, etc.

AEP or Aerodrome Emergency Planning helps to achieve cooperation and coordination with a set of instructions. This ensures quick response to rescue and firefighting, law enforcement, medical aid, security, and police services, etc. Emergency mutual aid agreements are signed to define the responsibilities of the contributing parties.

The given unit explains the need to prepare and deal with various safety/security occurrences.

Aerodrome Emergency Planning

In order to cope with the emergency, if it occurs at the airport or in the vicinity of the airport, the airport operator should be prepared to meet with such a situation. The planning for such a situation is termed Aerodrome Emergency Planning (AEP).

If the airport has emergency planning already in place, it will enable the operator to act quickly to minimize the impact of the emergency. This is particularly most specific to the aircraft emergency where such planning will ensure the saving of lives and the extent of damage to aircraft. If the aircraft has only declared an emergency, for example, while landing due to some technical glitch, if there is an emergency planning in place and precautions taken, it can minimize the impact when the aircraft lands on the runway by keeping the Fire Vehicles ready to extinguish in case of an aircraft fire. Also, through emergency planning procedures and processes, the airport can be put into normal operation at the earliest and smoothly once the emergency is dealt with safely.

AEP ensures:

ICAO Annex 14 specifies the Standard and Recommended Practices for AEP and for the implementation guidelines refer to Airport Services Manual (Doc 9137), Part 7.

ICAO Annex 14 mandates aerodromes to establish an aerodrome emergency plan at an aerodrome.

The following are the SARPS:

- An AEP shall be established at an aerodrome corresponding with aircraft operations and other required activities
- The AEP shall coordinate actions to be taken in an emergency occurring at an aerodrome or nearby
- AEP will coordinate the actions and participation of the existing agencies which would be considered appropriate for providing assistance in case of an emergency
- The plan would coordinate with the rescue coordination center if required
- There must be a fixed emergency operations center and a mobile command post to render services during an emergency. The emergency center should be a part of the aerodrome facilities and should undertake responsibilities to coordinate and direct responses in case of an emergency. At the same time, the command post should be capable of being moved to a site of emergency at the time of need.
- Competent staff should be assigned to assume handle control of the emergency operations center and the command post
- There must be an efficient communication system that links the emergency operations center and the command post
- The participating agencies should be provided in accordance with the plan and consistent with the requirements of the aerodrome
- The appropriate specialist rescue services must be readily available

Examples of Emergencies

Emergencies directly involving aircraft, sabotage including bomb threats, unlawfully seized aircraft, occurrences while transporting dangerous goods, building fires, natural disasters and includes public health emergencies.

Public health emergencies include the risk of spreading a communicable disease through travelers or cargo. Air transport can lead to a severe outbreak of a communicable disease potentially affecting a large proportion of aerodrome staff.

Different types of emergencies that can be anticipated are:

Emergencies involving aircraft	Emergencies not involving aircraft	Combination of these emergencies
Accidents: aircraft on-airport, aircraft off-airport on land or in water	Building (Structural) Fire	Aircraft/structures
Incidents: aircraft in flight like severe turbulence, decompression, structural failure or aircraft on the ground, sabotage including a bomb threat, unlawful seizure	Sabotage including bomb threats (in a building)	Aircraft/fueling facilities
	Natural disasters like cyclonic storms, floods, earthquakes	Aircraft/Aircraft
	Transportation of dangerous goods (while in storage)	
	Medical emergencies (on the ground)	

Agencies to be involved in the emergency are classified as:

a) In the aerodrome:

- Air traffic control units
- Rescue and firefighting services
- Aerodrome administration
- Medical and ambulance services
- Aircraft operators
- Security services
- Police

b) Off the aerodrome:

- City fire departments
- Police
- Health authorities (including medical, ambulance, hospital, and public health services)
- Military
- Local Administration
- Harbor patrol or coast guard

AEP is prepared after consultation with all agencies which the concerned authority thinks would be suitable to provide emergency services. The agencies should be well aware of their roles and responsibilities and also those of other agencies to establish coordination and carry out an effective AEP.

AEP will be implemented irrespective of whether it is an on-airport or an off-airport aircraft accident, subject to a few changes. In the case of an "on-airport" aircraft accident/ incident, the Airport Authority will normally be in command. At the same time, in the case of an off-airport aircraft accident/ incident, the agency agreed upon with mutual consultation will take charge.

For any accident occurring "just outside the airport perimeter", the responsibility will be as agreed upon in the mutual aid emergency agreement pre-arranged with the surrounding community. However, airport personnel and other agencies should not hesitate to participate actively in such a situation and the responsibilities of the surrounding community should also not affect such a response.

The usual aircraft emergencies calling for services are:

- **Aircraft accident** is one that has occurred in or in the vicinity of the airport.
- **Full emergency** is when an aircraft approaching the airport is or is suspected to be, in such trouble that there is imminent danger of an accident; and
- **Local standby** is when an aircraft approaching the airport is known or is suspected to have developed some defect, but the trouble is not such as would normally involve any serious difficulty in effecting a safe landing.

In the case of a medical emergency, the type of illness and degree of severity would decide the extent of support required. Airports usually have basic medical aids, medical supervision facilities, and provision for beds for the needy. Such facilities are also required by passengers having minor illness conditions.

The severity of medical illness determines the need to implement the medical emergency plan and the extent to which it has to be implemented. The spread of communicable diseases, sudden serious illness or injury, or anything highly serious is beyond the scope of the medical support available at the airports.

The Airport Authority and the airport operator of

the respective airport hold the responsibility to establish emergency procedures to tackle unusual situations. The plans and procedures are in sync with surrounding community authorities.

Periodic testing of AEP is mandatory as per the ICAO. A full-scale aerodrome emergency exercise at intervals not exceeding two years and partial emergency exercises in the intervening year. In case

To be operationally sound, a comprehensive airport emergency plan must consider:

Preplanning **BEFORE an emergency** so that the least time is spent on preparation to tackle the emergency

Operations **DURING the emergency** like who are all involved, their roles, and responsibilities

Support and document **AFTER the emergency** to record the learnings from the emergency plan implementation and take corrective actions if required, for a better response next time any loopholes are identified during the full-scale exercise, corrective actions are taken and modified plans are tested during partial exercises or during a series of modular tests carried out commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years.

Any off-airport accidents that occur in difficult-to-access locations such as deserts, marshes, adjacent mountains, etc. create severe logistics issues. Therefore, adequate plans must be designed to deal with issues in these areas, for instance, provisions can be made for special service vehicles like rescue boats, helicopters, hovercraft, swamp buggies, etc. Plans must be laid down in advance to provide support in such cases.

Outline of Emergency Plan

Given below are the guidelines which can support airport authorities to carry on with emergency procedures:

- Clearly define the responsibilities of the airport authority and other participating agencies
- Ensure effective communication exists. There must be ample facilities to communicate and identify a "cascade" call system to include persons/agencies responsible for "cascade" information. Try to incorporate 24X7 communication availability.
- Ensure provision for a fixed emergency operations center and a command post at the airport
- Integrate assistance from local support activities like fire departments, police, medical centers, security, and even a local radio/tv channel
- Describe the function of air traffic services relating to emergency actions
- Clearly specify instructions for response to accidents

The AEP must be documented to facilitate the identification of subject matters relevant to the local airport and community conditions. The plans and procedures should be issued under the concerned authority. The authority will define the responsibilities and negotiate these to concerned staff members and agencies responsible for handling emergencies.

The plans and procedures should be simple to understand and the arrangements should encourage participation by all those involved.

Examples of Contents of Emergency Plan Document

Section 2 to 8 describes the specific actions by various agencies and within airport authority various departments

Aircraft Rescue and Fire Fighting (ARFF) Services

These services must be provided at all airports in conformity with ICAO SARPs and Guidelines provided in Airport Services Manual- 9137 Part 1.

Firefighting in and around a crashed aircraft requires a high degree of specialization. ARFF fighters must be competent enough and possess characteristics like courage, dedication, agility, and physical strength. They must work as a team to fight against dangerous situations. The need for extinguishing a fire may be at the time of aircraft landing or take off, taxing or even when parked, or may occur immediately following an aircraft accident or incident or may occur at any time during

rescue operations.

Objectives of ARFF

- To create and maintain conditions for survival
- To provide safe outlets for occupants
- To rescue occupants who need support to make an escape

The most important factors bearing on effective rescue in a survivable aircraft accident are:

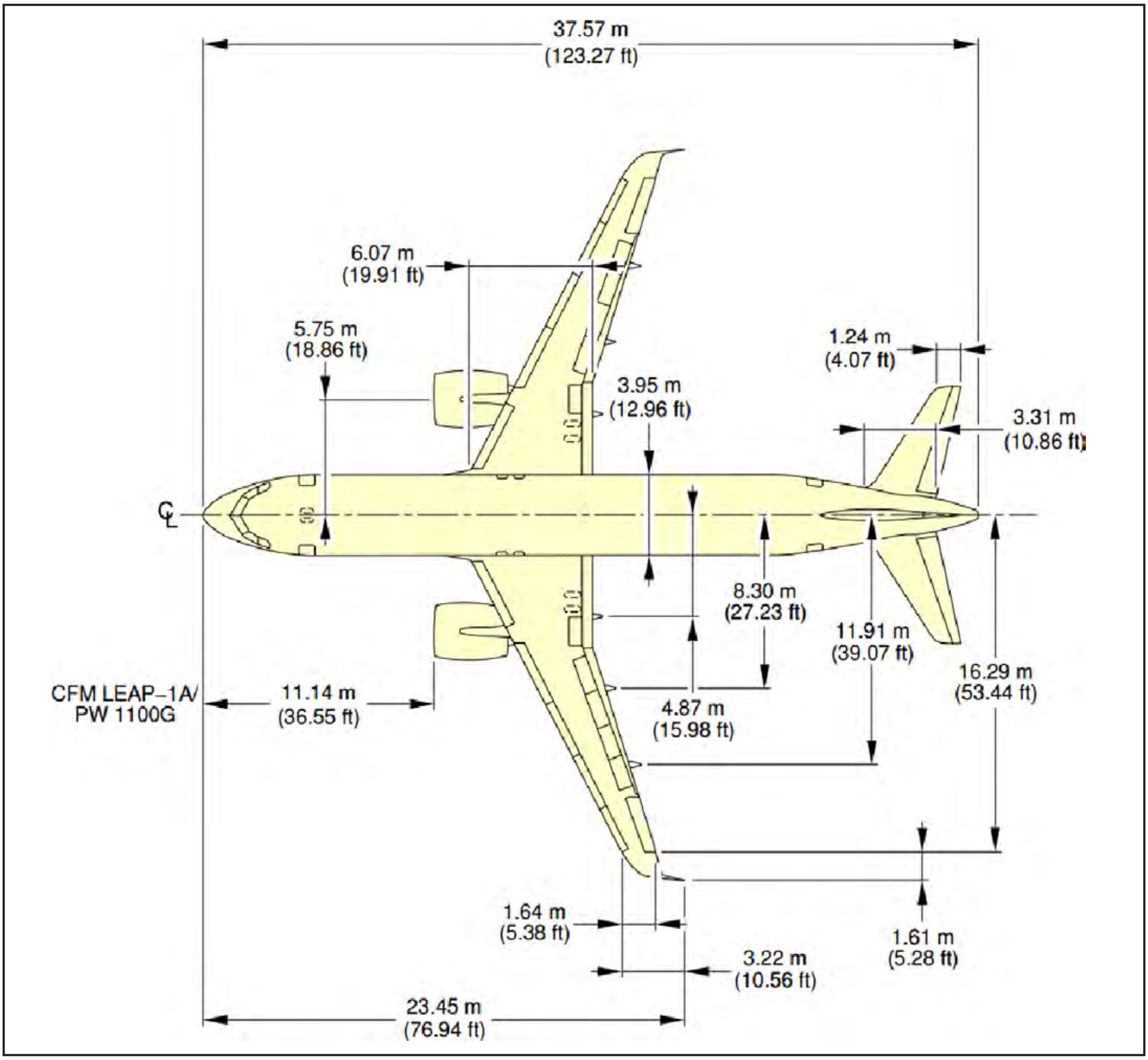
- Effectiveness of the equipment being used
- Training of the personnel involved in rescue operations
- The speed with which the designated personnel and equipment for rescue reach at the location

To determine the number of fire vehicles required and the quantity of extinguishing agents the vehicles must carry is defined by what is termed as 'level of protection. The Level of protection is the minimum number of RFF vehicles that are required and the minimum quantity of extinguishing agents each vehicle should carry and is based on the aerodrome category determined for this purpose. The aerodrome category is determined based on the overall length of the aircraft and or the aircraft fuselage width as per the table below:

Table: Aerodrome categories, their overall length, and maximum fuselage width

Aerodrome Category	Airplane Overall Length	Maximum Fuselage Width
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

The figure given here gives an overview of overall length and fuselage width of an aircraft:



The aircraft shown in the given figure is A 320/200 and the aerodrome category for the purpose of level of protection is 6 for this aircraft.

Assume an aircraft whose length is 75m and fuselage width is 7.1m. The aerodrome category for the length of the aircraft is Cat 9 but the fuselage width for Cat 7 has to be less than 7. Whereas, for this aircraft, it is more than 7 and hence, for this aircraft, the category will be 10.

For the aerodrome, consider the most demanding aircraft for the purpose of the aerodrome category. However, if the most demanding aircraft has less than 900 movements in a year, you can choose one category less than what is arrived with the most demanding aircraft. Taking the above example, if the most demanding aircraft requires category 10 but if its movements in a year are less than 900 numbers, we can go ahead with category 9 instead of 10.

After determining the aerodrome category for the purpose of ARFF, we need to find out the number of RFF vehicles and the quantity of extinguishing agents required. These are tabulated in table 8.2. The number of vehicles mentioned are the minimum to be maintained for operations.

Table: Aerodrome categories – number of RFF vehicles

Aerodrome Category	Number of RFF Vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Table: Minimum usable extinguishing agents

	Foam Meeting Performance Level A		Foam Meeting Performance Level B		Foam Meeting Performance Level C		Complementary Agents	
Aero-drome Category	Water (L)	Discharge Rate Foam Solution Per Minute (L)	Water (L)	Discharge Rate Foam Solution Per Minute (L)	Water (L)	Discharge Rate Foam Solution Per Minute (L)	Dry Chemical Powder (Kg)	Dis-charge Rate (Kg/ Sec)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1000	800	670	550	460	360	90	2.25
3	1800	1300	1200	900	820	630	135	2.25
4	3600	2600	2400	1800	1700	1100	135	2.25
5	8100	4500	5400	3000	3900	2200	180	2.25
6	11800	6000	7900	4000	5800	2900	225	2.25
7	18200	7900	12100	5300	8800	3800	225	2.25
8	27300	10800	18200	7200	12800	5100	450	4.5
9	36400	13500	24300	9000	17100	6300	450	4.5
10	48200	16600	32300	11200	22800	7900	450	4.5

Principle agent gives permanent control and complementary agents provide temporary control. These complementary agents have a rapid-fire suppression capability available only during the application.

If we see from the Aircraft fire point of view, Class B fires are the most important. Such fires occur with flammable liquid substances like gasoline, jet fuels, paints, grease, and any petroleum-based product. In order to extinguish Class B fire, a barrier is provided between the burning substance and oxygen necessary for combustion. These barriers are provided with chemical and mechanical foams that provide temporary support. The re-application is required in case fire re-ignites. The extinguishing agents recommended for combating class B fires are CO2, PKP, Halon, and Aqueous Film-Forming Foam (AFFF). Note that, it is advisable not to use water to extinguish class B fires.

Class D fires are combustible metals like magnesium and titanium for which water in large quantities, as the high-velocity fog, is recommended as an extinguishing agent. However, firefighters should apply water from a safe distance as application of water to Class D fire can lead to small explosions.

Response Time for ARFF Services

For the effectiveness of the firefighting operation, the fire vehicles must reach the accident /incident site within a reasonable time period, which should be as quickly as possible, after receiving calls from the ATC controller. This minimum reasonable time has been worded as response time in ICAO SARPs.

Response time can be understood as: "the time between the initial call to the rescue and firefighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 percent of the specified discharge rate".

RFF vehicles must reach the accident location at the earliest in order to reduce the spread of fire and/ or to contain the fire and rescue the occupants of the aircraft. The required response time is specified in ICAO- SARPs.

The response time should not exceed three minutes to any point of each operational runway, in optimum visibility and surface conditions. It is advisable that the fire stations where vehicles are stationed are located near the most appropriate location on the airside.

Some principles of SARPs are:

- All rescue and firefighting vehicles should normally be housed in a fire station
- Location of a fire station should be such that the access for rescue and firefighting vehicles into the runway area is direct and with a minimum number of turns
- More than one fire station may be required if response time cannot be achieved with one fire station (generally, due to the longer length of the runway). When there are two fire stations one is designated as the Main and the 2nd one as the Satellite fire station
- Fire station will have a watch tower and there should be a direct view of the runway and

Table: Suggested minimum technical specifications of fire vehicles

Parameter	Vehicles up to 4500 Lit	Vehicles over 4500 Lit
Monitor	Optional for categories 1 &2 Required for categories 3 to 9	Required for all categories
Design Feature	High Discharge capacity	High & Low Discharge capacity
Range	Appropriate to the longest airplane	Appropriate to the longest airplane
handlines	Required	Required
Under truck nozzles	Optional	Required
Bumper Turret	Optional	Optional
Acceleration	80 Km/h within 25 sec at the normal operating temperature	80 Km/h within 40 sec at the normal operating temperature
Top speed	At least 105 Km/h	At least 100 Km/h
All-wheel drive capability	Yes	Yes
Automatic or Semi-automatic transmission	Yes	Required
Single rear wheel configuration	Preferable for categories 1 & 2; required for all other categories	Required for all categories
Minimum angle of approach and departure	30 degrees	30 degrees
Minimum angle of tilt (Static)	30 degrees	28 degrees

movement area without any obstructions

- If there are two fire stations, the main fire station will have a watch tower. The satellite fire station will have one fire vehicle and remaining vehicles parked in main station

The emergency exits in an aircraft are of prime importance. If the emergency door is to be opened from outside the aircraft, the RFF vehicles and rescue teams should have appropriate tools and devices. The minimum required tools, protective clothing and respiratory equipment are also specified in Airport Services Manual.

Protective clothing is required to protect the firefighters from radiated heat and from injuries arising from impact or abrasion during RFF operations. These are used not only during RFF operations but also during training. The specifications of these are as per the guidelines provided in ASM. Protective clothing includes:

Respiratory equipment is required to protect the firefighters against gases that may be produced due to the burning of cabin interior materials. Firefighters need to enter the cabin filled with gases and smoke and they require equipment of approved design.

The firefighters are also to be competent enough, through training and mock drills, to wear this equipment/clothing as quickly as possible. Effective rescue in a survivable accident can be achieved with properly and adequately trained and retrained personnel, the effectiveness of the equipment, which is tested and trials carried out, and the speed with which the firefighters and equipment can be put into action.

The most important guide for the RFF vehicle drivers is the detailed airport grid map and map to reach the immediate vicinity of the airport. Information that is required is topography, access roads, and location of water sources. Such a map is required to be pasted in the ATC tower, fire watch tower, fire station, RFF vehicles, and other supporting vehicles like ambulances. The vehicle drivers should be familiar with the map to identify crucial details and be able to drive to the location with the least difficulty.

Guidance to the drivers includes GPS installed in the vehicles, radio communication with ATC, and collision avoidance facility installed in the vehicle.

Copies of the map can also be with the city fire brigade, designated hospitals, and police for this purpose. Coordination between the airport and city fire brigades, hospitals, and police would also be required and they should be part of aerodrome emergency planning.

Essentials of an effective communication system:

- Ensure direct communication between fire stations and RFF vehicles and between the vehicles
- Ensure direct communication between ATC and fire stations
- Ensure a direct communication system through dedicated lines between the ATC tower and fire stations as the call to the fire station originates from the ATC tower
- An effective alarm system to alert the fire brigade
- PA system in fire stations in direct connection to the ATC tower to convey details of the emergency, location, type of aircraft involved, and preferential routing for RFF vehicles

It has been noticed that most of the accidents occur on or close to the runways or in the area beyond the runway. Therefore, emergency access roads need to be provided to facilitate minimum response time. Such a road is constructed from the runway threshold to the approach area up to 1 km distance. To reach outside the airport from this point, a crash gate is provided on the fence. Adequate water storage should be available at the fire stations and near the airport boundary at the runway ends.

Preventive Maintenance- ICAO SARPs require that

a system of preventive maintenance of rescue and firefighting vehicles should be employed to ensure the effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle. To comply with this requirement, preventive maintenance plans are prepared for the fire and rescue equipment and implemented as per the plan to ensure their serviceability and compliance with performance specifications.

Summary

An emergency can be efficiently dealt only with the cooperation and coordination with not only all the aviation stakeholders but also local administration, surrounding community, law and order agency, local fire services, etc. In order to cope with the emergency, if it occurs at the airport or in the vicinity of the airport, the airport operator should be prepared to meet with such a situation. The planning for such a situation is termed Aerodrome Emergency Planning (AEP).

ICAO Annex 14 specifies the Standard and Recommended Practices for AEP and for the implementation guidelines refer to Airport Services Manual (Doc 9137), Part 7.

AEP is prepared after consultation with all agencies which the concerned authority thinks would be suitable to provide emergency services. The agencies should be well aware of their roles and responsibilities and also those of other agencies to establish coordination and carry out an effective AEP.

AEP will be implemented irrespective of whether it is an on-airport or an off-airport aircraft accident, subject to a few changes.

Unit 11

Overview of Aviation Security

Learning Objectives

By the end of this unit, you will be able to:

- Describe National Civil Aviation Security Program
- Discuss Aviation Security Training Packages (ASTP) as per ICAO
- Analyze measures related to secured areas access in airports
- Examine preventive measures related to baggage, cargo, special categories of passengers, and landside

Introduction

ICAO mandates that the States apply the standards as per SARPs and make all attempts to apply the recommended practices of SARPs. Security and facilitation go hand-in-hand. ICAO requires States to arrange for security control measures wherever possible with the least interference with the activities of civil aviation to avoid any delays and obstruct the effectiveness of security concerns. It must be ensured that an aircraft's turnaround time is not affected due to security reasons and that the passengers do not get disturbed by security precautions being taken.

The given unit gives an insight into various programs being run to ensure proper airport security.

Aviation Security

Aviation security is implemented and managed by ICAO SARPs specified in Annex 17 and detailed guidelines specified in Aviation Security Manual-ICAO Doc 8973. This Doc 8973 is restricted and is not a public document. Hence, the description is based on the ICAO SARPs of Annex 17 and practiced by the industry.

Given below are the State's objectives as per ICAO/ Annex 17:

- Safety concern is the prime objective. It includes the safety of not only the passengers but also the crew members, ground staff, and the general public in all matters related to safeguarding against unlawful interference with civil aviation.

  The acts of unlawful interference include attempts such as:

  - Unlawful seizure of aircraft
  - Destruction of an aircraft in service
  - Hostage-taking on aerodromes or onboard aircraft
  - Forceful intrusion
  - Introduction of a hazardous weapon or any such device that can cause harm at the airport or an aircraft
  - Misleading information to endanger the safety of an aircraft, passengers, crew, staff members, and others at the airport or on civil aviation premises
- Develop and implement rules and regulations to protect civil aviation against unlawful activities that hamper security
- Ensure policies and procedures comply with security concerns

- Employ safety equipment where appropriate and also ensure effective functionality of the equipment

As a part of international cooperation, which is very much required for effective security management, ICAO mandates that if a State requires additional security measures in respect of specific flights this shall comply with the State in which the airline of the requested State is operating. For example, secondary check requirement at the boarding gates before boarding the passengers for specific airlines, in addition to the primary security check.

Cooperation between the States is required so that the exchange of information and development of security measures concerned with the aviation sector can be feasible. ICAO requires States to share the audit results and corrective measures that have been taken if any.

States should also include a clause concerning aviation security in bilateral agreements on air transport. At the same time, collaborative arrangements must be made to enhance the sustainability of the aviation security system, Efforts must be taken to reduce and remove duplicity. States must also promote innovation and development activities with respect to new security equipment, processes, and procedures. The ultimate aim should be directed toward the achievement of civil aviation objectives in cooperation with each other.

National Civil Aviation Security Program (NCASP)

ICAO mandates State:

- To establish and implement a written NCASP to protect civil aviation operations against unlawful interference
- To designate and specify to ICAO an appropriate authority within its administration that holds responsibility for the development and maintenance of the national civil aviation security program. In India, the Bureau of Civil Aviation Security (BCAS) is the organization (regulator) for aviation security.

- To review the level of threat to civil aviation within its scope and airspace above it. Policies should be established to facilitate the assessment of security risks carried out by the relevant national authorities.

ICAO Doc 8973 (Restricted Doc) presents a model national program that is simple in structure and content, containing national policy directives rather than specific operational details. Implementation of national policy is contained in other documents, such as airport security programs and contingency plans, which are attached to the national program as appendices. This way the national program is shared with many organizations both within and outside the State but the sensitive implementation guidelines are made available only to the respective organizations.

For the development of an NCASP, a team is required to be identified with personnel having adequate experience in aviation security matters. NCASP is developed based on Annex 17, Manual 8973, and other ICAO docs relevant to security & facilitation and States' Legislations, Aviation Acts, Relevant Laws (criminal, civil, etc.), Treaties between States, Regulations, Memorandum of Understanding if any, etc. The first step of NCASP development can be writing an objective of the program. Designation of an appropriate authority is essential with an organization chart for the implementation/ monitoring/ updating of the NCASP

As the NCASP caters to the State and to all the stakeholders of aviation - airports, airlines, police, customs, and even the concessionaires at the airport, etc. all the stakeholders are part of this program for implementation, monitoring, and improvement. They should be consulted, and their cooperation is ensured. NCASP will also specify the role and responsibility of each of the stakeholders including appropriate authority. The program specifies security measures planned at the aviation facilities based on the threat evaluation. It provides for sufficient resources and training of personnel involved in security. The program should also specify a process to monitor the implementation, review, and evaluate its effectiveness for improvement. The program also enables communication with ICAO with reports on security-related incidents periodically.

In respect of facilities design to cater for security measures to be implemented including structural capability etc., such specific guidelines and approval processes will be part of the program. The exchange of information and cooperation between States is an important aspect of security programs that can help States while dealing with unlawful interference. The above is only a brief on NCASP and more details can be seen while working on NCASP.

Appropriate sections of NCASP are shared with relevant stakeholders- airports, ANS providers, aircraft operators, etc. NCASP is periodically reviewed in order to ensure that it is relevant with respect to the security threat environment at the time.

National Aviation Security Committee

It is mandatory as specified by ICAO that States should establish national aviation security **Air-**

committee or provide for similar arrangements so that coordination can be established between the departments, agencies, and other organizations of the State, airport and aircraft operators, air traffic service providers, and other entities with regard to security activities.

This committee is represented by Government Authorities and Aviation industry representatives who advise on security policies and review the various security measures/procedures that are in practice and recommend additional/ modified measures & procedures to enhance the effectiveness. This committee is useful with many airports in the States to have coordinated efforts across the States. The committee meets periodically.

Training of Personnel

ICAO also makes it mandatory for the concerned authorities to arrange for training activities for staff members and other entities who are responsible for carrying out the national civil aviation security program. The training program shall be designed such that it contributes to the effectiveness of the security program. It is also obligatory for the States to ensure the development and implementation of training programs and an instructor certification system in accordance with the national civil aviation

security program.

Aviation Security Training Packages (ASTP) as per ICAO

Aviation Security National Instructors

The course has been designed for the staff members and other personnel involved in the development, management, and/or instruction of training materials related to a national civil aviation security training program. After completing the course, the personnel would be able to apply training principles as per requirements. However, to get the training, the person should have a foundation of AVSEC knowledge and exposure to AVSEC training material. The duration of the course is 7 days.

Airport Security Supervisors

This course is designed to ensure that relevant personnel at airports can supervise and monitor the implementation of aviation security preventive measures through the application of the relevant competencies required for security supervisors. Participants of this course will be prepared to plan, coordinate and conduct quality control measures utilizing Annex 17 and ICAO methodology in accordance with approved programs.

Air-Cargo and Mail Security

This five-day course is designed to ensure that the relevant personnel can integrate the knowledge of Standards and Recommended Practices (SARPs) into the context of their designated role in their organization as part of a national responsibility to secure air cargo and mail against acts of unlawful interference, through the application of the relevant competencies and in accordance with Annex 17 and the ICAO Aviation Security Manual (Doc 8973).

Aviation Security National Instructors

This seven-day course is designed to provide aviation security personnel with theoretical and practical knowledge of audits and inspections as part of a national civil aviation security quality control program. Participants who successfully complete this course will be prepared to plan, coordinate and conduct quality control measures utilizing Annex 17 and ICAO methodology in accordance with approved programs.

Utilizing the principles of the ICAO TRAINAIR methodology, the course documentation for each ASTP contains all the material required for the conduct of a particular course, including instructor guides, student handout material, exercises, tests, and training aids, the aim being that the quality and integrity of each course remains constant regardless of the instructor and that any instructor competent in the aviation security discipline will require a minimum of preparation time to deliver the course.

There are 27 Aviation Security Training Institutes in India established by airports and airline operators mainly. There are eight courses conducted by these ASTIs. The list of courses along with the number of

days of training, target group, etc. can be seen on the BCAS website.

BCAS also publishes a yearly training calendar for the following

- Testing and certification of screeners
- AvSEC basic course
- ASTC course

The Basic AVSEC and Screener's certification program is a recurring requirement. All the employees of civil aviation organizations need certification as mandated by NCASTP and other BCAS guidelines issued under section 5A of the Aircraft Act 1934 and Aircraft Security rule 2011(as amended) by the appropriate authority.

ICAO has about 35 Aviation Security Training Centers (ASTCs) worldwide. These centers not only impart training but also develop and deliver an annual program of Regional Aviation Security Courses adapted to regional needs. ASTC for India is the 'Indian Aviation Academy, New Delhi. 10 Training programs are sponsored by BCAS at ASTC India.

Airport Security Program

For the States, the NCASP is the document based on which security management is performed which includes the State's and Service Providers' roles, responsibilities, and security measures among others. The NCASP is an airport security program for a particular airport is developed. ICAO mandates each airport serving civil aviation to establish, implement and maintain a written airport security program appropriate to meet the requirements of the national civil aviation security program. Airport Security Program is required to be approved by the State's appropriate authority. The program shall also specify the roles and responsibilities of the

airport, aircraft operator personnel, and security personnel in response to unlawful interference.

The program includes procedures with dos and don'ts in such events including evacuation procedures of buildings.

As mandated by ICAO each airport shall have an authority, designated as an airport security officer, for coordinating and implementing security controls. The officer directly reports to the Chief of the airport and should have adequate knowledge and experience in aviation security procedures, and measures as specified in the security program and technology. The officer conducts regular inspections, periodic audits, etc. to ensure the security measures as per the airport security program are implemented and whether modifications or improvements are required. He also shares such inspection /audit reports with relevant organizations. He is also responsible to initiate action in the event of unlawful interference as per the security program.

In order to ensure the security measures and procedures as per NCASP are implementable, the airport's design shall be coordinated, and requirements incorporated into the design in respect of structural, architectural, and spatial requirements including new and expansion to existing airport facilities.

ICAO mandates States to establish an airport security committee at each airport serving civil aviation to assist the airport security officer in its role of coordinating the implementation of security controls and procedures as specified in the airport security program. The committee members are personnel from the airport operator, aircraft operators, and all other relevant stakeholders of the airport. The terms of reference for the airport security committee are specified in Doc 8973 (Restricted).

Aircraft Operators Security Program

Similar to the airport operator, maintaining an airport security program in line with NCASP, ICAO mandates aircraft operators to establish, implement and maintain a written operator security program that meets NCASP of that State. The aircraft operator's security program details the measures for ensuring compliance to ICAO- Annex 17 SARPs in respect of security measures for holding bags, cargo, unauthorized access to aircraft, a response by crew/aircraft operator personnel in the event of unlawful interference, etc.

Annex 6 – Operation of Aircraft also prescribes that:

Operators will implement training programs to train employees to act in the most appropriate manner so that unlawful interference is reduced

Pilots-in-command should submit reports on acts of unlawful interference

Availability of a checklist to describe the procedures for a bomb search

The flight crew compartment door on passenger-carrying aircraft should be such that it can be locked from within the flight deck compartment

The chief security officer of the aircraft operator will direct report to the corporate level officer like the COO and will have adequate knowledge and experience in security management and familiarity with aircraft and airline operations, as he is responsible for the implementation of the operator's security program.

The suggested outline of the operator security program is described in Doc 8973

Air Traffic Service Providers Security Program

It is mandatory for air traffic service providers to establish and implement adequate and appropriate security provisions as per the requirements of the

national civil aviation security program of the State in which they are operating.

Quality Control and Qualifications

ICAO Annex 17 SARPS specifies the following:

- There should be a thorough investigation of the backgrounds of those involved in implementing security controls
- All those who are responsible for implementing security controls must be competent and well-trained to perform their duties. Relevant standards of performance should be established and periodic assessment needs to be done.
- All those responsible for carrying out screening operations must be certified as per the requirements of the national civil aviation security program. This will help in attaining consistency and reliability in performance standards.
- There has to be an appropriate authority to develop, implement and maintain a national civil aviation security quality control program. This will confirm the validity of an effective NCASP.
- The security measures must comply with the NCASP. Therefore, periodic assessments must be carried out by relevant authorities. Verification can be done with the help of security audits, tests, surveys, and inspections. This will help to verify compliance with the national civil aviation security programs and also help to find out any loopholes.
- Management, setting of priorities, and organization of the national civil aviation security quality control program shall be undertaken independently from the entities and persons responsible for the implementation of the measures taken under the national civil aviation security program.

The QC program ICAO also makes it compulsory that:

- Those who carry out security audits, tests, surveys, and inspections must also be thoroughly trained as well as must possess the authority to seek information and enforce corrective actions
- A confidential reporting system to supplement the national civil aviation security quality control program so that security information can be generated and assessed
- A process to record and assess the results of the national civil aviation security quality control program should be established. This will help in developing and implementing the program effectively.

ICAO also mandates the appropriate authorities of the State to re-evaluate controls and procedures in due time and take corrective measures to prevent any reoccurrence of deviations and also report the same to the ICAO.

Carriage of Prohibited Items

The passengers and crew members are prohibited to carry certain items as prescribed by the Security Regulator. These include weapons, explosives, or any other dangerous devices, articles, or substances which can be used to commit any unlawful activity. The State issues measures to prohibit the carrying of such items.

Routine checks and other unpredictable security measures are taken to keep a check on the bearing of prohibited items. At the same time, training is given to identify any suspicious behavior and detect the carriage of restricted items.

Measures Related to Secured Areas Access in Airport

States implement controlled access to the airside areas at the airport to ensure only authorized personnel are allowed to enter. For implementing this preventive measure, there shall be an identification system like an Airport Entry Permit for the staff and other personnel who must be in these areas as part of their duties and responsibilities. Such AEP will specifically mention permission to access the airside and other areas. The issue of AEP does not mean that it is for all airport areas, AEP will specify permits to enter specific areas where the holder of the permit is allowed to enter. For the vehicles entering the airside, an entry permit called an 'airside vehicle permit is issued by the airports for the vehicle with the registration number of the vehicle, validity, and other details. Entry to such vehicles is subject to security checks for items carried through the vehicle.

At airport security, restricted areas are to be established for the buildings to exercise more control to access these areas. For example, the passenger terminal building after the security check will normally be designated as security restricted area since it has direct access to the airside and aircraft. Identification of persons entering this area is implemented for example boarding passes of passengers entering the gate hold area.

For staff working at the airport, i.e., other than passengers, access to the security restricted area is through the 'Airport Entry Permit' issued by BCAS specifically mentioning the areas allowed to visit for duty purposes. For such personnel, it is mandated to carry out background checks before the AEP is issued.

ICAO mandates that the movement of persons and vehicles to and from the aircraft shall be supervised in security-restricted areas in order to prevent unauthorized access to aircraft. The items like tools and equipment or materials carried out into the airside or security-restricted areas will have to be checked either manually or through screening machines. The personnel will also be checked with metal detectors to ensure they don't carry any unauthorized objects into the airside or security-restricted areas.

At the airside- landside interface gates with security equipment will be provided and such a number of gates will be minimized to have limited access to the airside. Security personnel will be positioned at such gates to ensure controlled access.

ICAO recommends the issue of identity documents to crew members. This will facilitate a valid and reliable basis for recognition globally, and permit authorized access to airside and security-restricted areas in accordance with the specifications set forth in Doc 9303, Machine Readable Travel Documents.

Entry to the passenger terminal building is only for genuine passengers and the security personnel will check the valid boarding pass or flight ticket with the identity of the passengers ensured through one of the prescribed identity cards. This is the process followed in India as per BCAS guidelines. Also, randomly the baggage of the passengers can also be screened as required. Staff on duty shall have an airport entry permit issued by BCAS with areas of permit clearly specified.

There are some States which do not have any access restrictions for non-passengers till the check-in area.

For the issuance of airport entry permit for the staff, BCAS has specific guidelines and the permit is issued only after the staff undergo security training so that they are aware of the security requirement. Similarly, the process for issuing a temporary permit for the contractor's personnel is also specified by BCAS.

Preventive Measures Related to Aircraft

It is mandatory to implement aircraft security checks. The concern if it is a security check or a search will depend upon the security risk assessment carried out by the relevant national authorities. A security check makes sure that any item left by any of the passengers is removed from the aircraft or otherwise dealt with appropriately before the aircraft departure. The security checks ensure that there are no issues and the aircraft shall be protected from unauthorized interference till departure.

ICAO also mandates that States will make sure that appropriate measures and operational procedures have been taken to lessen possible attacks using

Man-Portable Air Defense Systems (MANPADS) and other weapons representing a similar threat to aircraft at or near an airport.

Preventive Measures Relating to Passengers and their Cabin (Hand) Baggage

Ensure those originating passengers of commercial air transport operations and their cabin baggage are screened prior to boarding an aircraft departing from a security-restricted area. ICAO does not specify any particular technology for the screening equipment. BCAS provides the specifications of the screening equipment in terms of their performance in identifying prohibited items being carried into the aircraft or into the security-restricted area. The list of prohibited items is published by BCAS and this undergoes change depending on the threat perception at the airports or some guidelines/ practices from other states.

Also, ensure those transfer passengers of commercial air transport operations and their cabin baggage are screened prior to boarding an aircraft. This is the practice in India and several other States but ICAO provides some conditions to exempt this process.

The integrity of the screened passengers and their cabin baggage are protected without mixing of the passengers and cabin baggage with others not screened. If the passenger flow is such that there is a chance of mixing, in such cases the passengers and their cabin baggage are to be rechecked before boarding the aircraft.

What is the difference between transfer and transit passengers? Transfer passenger changes to another aircraft while traveling from airport A to C via airport B. Whereas transit passenger takes the same aircraft but travels from A to C via B

Ensure that practices are established at airports and onboard aircraft to assist in the identification and resolution of suspicious activity that may pose a threat to civil aviation.

Preventive Measures Related to Hold (Check-in) Baggage

Establish measures to make sure that hand baggage is screened before getting loaded onto an aircraft. Just like cabin baggage, the performance specifications of the screening equipment are specified by BCAS. Prohibited items are specified for check-in baggage, for example, power banks and electronic gadgets with lithium-ion batteries are not allowed in check-in luggage. These are to be kept in cabin luggage. The check-in baggage, like cabin luggage, is also screened and cleared for loading and shall be taken care of by the carrier after getting clearance from screening. In the case of any suspicion, the baggage shall be re-screened before being boarded on an aircraft.

Any baggage for which no passenger is identified is offloaded from the aircraft. In case of any luggage is found without a passenger detail, reconciliation is carried out either manually or through technology before the flight is cleared for departure.

Generally, all the airports screen the transfer baggage before loading it into the aircraft even though such baggage is checked in the previous airport. Commercial air transport operators carry only check-in baggage that has met the required criterion. In the case of unidentified baggage, the relevant national authorities indulge in security risk assessment.

Preventive Measures Related to Cargo, Mail, and Other Goods

Ensure that desired and necessary security controls have been taken care of in case of cargo and mail before these are loaded onto a commercial aircraft. Similar to check-in baggage and cabin baggage once the cargo and mail are screened the integrity of these are maintained by ensuring no interference to these, till loaded into the aircraft and departure from the aircraft. It is important to ensure that security measures are thoroughly implemented to mitigate any risk involved.

The operators will not accept any cargo or mail for carriage unless screening and other security requirements have been duly met. Cargo and mail which cannot be confirmed and accounted for by a regulated agent or an entity that is approved by an appropriate authority shall be subjected to screening.

Merchandise and supplies are also subject to screening before loading. The same holds true for mail to be carried. ICAO recommends and establishes appropriate mechanisms for screening and other security measures taking into account

the nature of the consignment.

Preventive Measures Related to Special Categories of Passengers

A special category of passengers is a potentially disruptive passenger who is to travel by aircraft from one airport to another airport/country because of judicial or administrative proceedings. States to develop requirements for such travel. The operator's security program shall include measures and procedures to ensure safety on board their aircraft. The aircraft operator and pilot in command are informed of such passengers to be on board the aircraft.

In the case of the carriage of weapons on board aircraft, by law enforcement officers and other authorized persons, acting in the performance of their duties, special authorization has to be obtained in accordance with the laws of the States involved. The permission to allow armed personnel to travel on board is given after the involved States permit to do so. In other cases, the carriage of weapons is allowed only when a duly authorized person confirms that the weapon is not loaded and is stored in a place that cannot be accessed by any person during flight time.

In-flight Security Officer: The deployment of in-flight

security officers must ensure that they are trained personnel and specially selected government officials. The deployment will be in accordance with the concerned States and not to be disclosed. The state shall also ensure that the pilot-in-command is notified as to the number of armed persons and their seat location.

Preventive Measures Related to the Landside

The landside areas need to be identified and security measures must be taken care of to lessen the risks and prevent possible acts of unlawful interference. The Standards must be specified between relevant departments, agencies, other organizations of the State, and other entities to ensure compliance with landside security measures.

Doc 8973 provides guidelines for:

- Surveillance of the airport- both landside and airside, terminal buildings, and vulnerable installations. Surveillance is through patrolling and or using CCTV coverage for live monitoring remotely.
- Protection of the Baggage handling system
- Parking of vehicles with minimum distance for short-term and long-term parking
- Airport perimeter protection particularly on the airside. Patrolling, watch towers, CCTV coverage for remote monitoring, and automatic intrusion detection systems.

- Procedures for the handling of unclaimed baggage and unattended baggage.
- Vulnerable points at the airport

Summary

Aviation security is implemented and managed by ICAO SARPs specified in Annex 17 and detailed guidelines specified in Aviation Security Manual- ICAO Doc 8973. This Doc 8973 is restricted and is not a public document.

It is mandatory as specified by ICAO that States should establish national aviation security committee or provide for similar arrangements so that coordination can be established between the departments, agencies, and other organizations of the State, airport and aircraft operators, air traffic service providers, and other entities with regard to security activities.

The passengers and crew members are prohibited to carry certain items as prescribed by the Security Regulator. It is mandatory to implement aircraft security checks. The concern if it is a security check or a search will depend upon the security risk assessment carried out by the relevant national authorities. Preventive and security measures are also taken with respect to cargo, mails, hand baggage, check-in baggage and special category of passengers.

Unit 12

Other Security Threats

Learning Objectives

By the end of this unit, you will be able to:

- Discuss measures related to cyber threats
- Explain prevention of acts of unlawful inter reference
- Understand response to acts of unlawful inter reference

Introduction

Security threats are common in the aviation sector. Therefore, it is imperative to undertake risk assessment activities to mitigate risks and threats. This is to be done in accordance with the State and airport authorities. Proper measures have to be taken to avoid and minimize risks. With emerging technologies, one of the risks is concerned with cyber threats.

The given unit gives an idea about measures related to cyber threats and how can unlawful interference can be avoided.

Measures Related to Cyber Threats

It is essential to safeguard the confidentiality, integrity, and availability of critical information. Risk assessment activities

make sure that the data system used for the safety of the aviation sector is protected so that the safety of civil aviation does not suffer.

States encourage all those bodies who are involved with the implementation of national civil aviation security programs to identify critical information and systems as well as understand risks and threats that can happen and take protective measures to mitigate these. The entities should design protective measures like supply chain security, network separation, and remote access control.

Management of Response to Acts of Unlawful Interference

Acts of unlawful interference mean hampering the safety and security of civil aviation and air transport. For instance, unlawful seizure of an aircraft on the ground, forcible intrusion on board an aircraft, hijacking, etc. Measures must be taken to prevent and minimize these unlawful activities. Mostly, efforts are taken to prevent these unlawful interferences.

As per Annex 17, Chicago Convention, member states of ICAO must report to ICAO once the issue gets resolved.

Prevention of Acts of Unlawful Inter reference

ICAO mandates States:

- Shall establish measures to protect an aircraft when it is informed that an aircraft is subject to unlawful interference while still on the ground, or effectively notify the concerned airport authorities and air traffic services before the arrival of an aircraft if it has already departed.
- Shall ensure that proper search action is implemented if it is informed that an aircraft

might have concealed weapons or any other hazardous equipment without disclosure. Prior notification of the search shall be provided to the operator concerned.

- Shall ensure that investigation arrangements have been made if any dangerous activities or hazardous devices are notified
- Shall ensure the contingency plans and availability of resources to protect civil aviation against any unlawful activity
- Shall ensure the availability of trained and competent staff for deployment at airports to deal with suspected and actual cases of unlawful interference with civil aviation

Response to Acts of Unlawful Inter Reference

ICAO mandates States:

- Shall ensure the safety of passengers and crew members in an aircraft which is subjected to an act of unlawful interference, while on the ground in the territory of the Contracting State, until their journey can be continued
- Holds responsibility for providing air traffic services for an aircraft, which is the subject of an act of unlawful interference, and shall collect necessary information and communicate it to all other States responsible for the air traffic services units concerned, including those at the airport of known or presumed destination. This will help in taking necessary actions to protect the aircraft while on route or at the possible destination.

- Shall provide support, navigation aids, air traffic services, and even permission to land an aircraft that is the subject of an act of unlawful interference
- Shall take steps to ensure the protection of human life for all those who are a part of an aircraft that is subjected to an act of unlawful seizure and has landed within its boundaries
- Shall initiate and proceed consultations between the State where that aircraft has landed and the State of the Operator of the aircraft, and notification by the State where the aircraft has landed to the States of assumed or stated destination

Any State where an aircraft subjected to an act of unlawful interference has landed shall notify in the quickest manner the State of Registry of the aircraft and the State of the Operator of the landing. The information should be transmitted to:

- The State of the Registry of the aircraft and the State of the Operator of the landing
- Each State whose citizens suffered fatalities
- Each State whose citizens are held as hostages
- Each State whose citizens are known to be on board the aircraft
- The International Civil Aviation Organization

The State shall cooperate with other states and try to provide a collective response against unlawful interference. Each contracting state should take initiatives to protect the passengers and crew members using the experience and capabilities of the State of the Operator, the State of manufacture, and the State of Registry of the aircraft which is subjected to unlawful activity.

Exchange of Information and Reporting

Once the issue has been handled, the state concerned with an act of unlawful interference will give all relevant information to ICAO regarding the security aspects of the unlawful interference. It is advisable to share such information with contracting States as well so that the response actions can be communicated for future references.

Summary

In accordance with the risk assessment carried out by its relevant national authorities States ensures that appropriate measures are developed in order to protect the confidentiality, integrity, and availability of critical information and communications technology systems and data used for civil aviation purposes from interference that may jeopardize the safety of civil aviation.

Unit 13

Aviation Cyber Security

Learning Objectives

After completion of this unit, the students will be able to explain:

- Describe initiatives, action plans, and guidelines from ICAO
- Discuss IATA's involvement, support, and action plan

Introduction

Like other industries, the aviation industry is also going towards a high degree of digitalization for ease of working, improved efficiency, reliability, faster processing, and quicker & easier retrieval of data when required. A high degree of digitalization is adding hazards as there is an interface of the system with people and this makes the risk harder to predict. Thus, the benefit of cyber technologies comes with increased insecurities and may affect all systems and infrastructures. The impact of cyber threats and cyber-attack is not restricted to the home country as the systems are interconnected globally. This aspect adds to the complexity and such attacks have wide implications for various industry players across the globe.

Aviation Cyber Security

As per IATA, aviation cyber security is defined as cyber security relating to aircraft and airport operations. The aviation industry uses information technology and communication (ITC) systems extensively and the systems of the various stakeholders are interconnected for information sharing and control & coordination.

Some examples of the systems are:

- Communication system used by airlines, airports, air traffic controllers, and ground handlers.
- Passenger-related systems like check-in system, baggage handling system, reconciliation of pax and baggage, flight information system, passenger manifesto, and biometrics data.
- Air navigation system
- Airport systems
- Operational & financial database
- Security screening, aircraft docking system
- Border control system

It is known that the aviation industry is an attractive target to create wide publicity if impacted and this is true for cyber-attack also. When the industry is impacted by such attacks, it affects the confidence and trust of the public and stakeholders.

An example could be given stating the incident which occurred at Ataturk Airport and Sabiha Gokcen International Airport in Istanbul, Turkey, in the year 2013 when the passport control process got affected and resulted in massive queues and delays for passengers.

ICAO has initiated steps to develop a solid cybersecurity framework. The purpose is to protect the critical infrastructure of civil aviation, safeguard IT and communication systems and prevent operational data against cyber threats. The 40th Session of the ICAO Assembly adopted Assembly Resolution A40-10 – Addressing Cybersecurity in Civil Aviation.

The resolution aims at addressing cybersecurity through a horizontal, cross-cutting, and functional approach. It insists upon implementing the ICAO Cybersecurity Strategy.

The assembly resolution reproduced is as below:

- Needs ICAO and the member States to promote and implement the Convention on the Suppression of Unlawful Acts Relating to International Civil Aviation (Beijing Convention) and Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft (Beijing Protocol) to deal with cyberattacks against civil aviation.
- Requires necessary actions to be taken by the States and other stakeholders in the aviation sector. The actions include:
    - Identification of probable threats and risks from cyber incidents and the serious effects of the same
    - Clearly defining the responsibilities of the concerned agencies to deal with cybersecurity threats
    - Promoting common understanding among member States. A common criterion needs to be established to assess critical areas, assets, and systems that need to be protected.
    - Promote coordination between the government bodies and the industry to establish policies and strategies to fight against cyber threats. There must be effective information sharing to facilitate identification of critical issues.
    - Adoption of a flexible approach to protect aviation sector and enable implementation of cybersecurity management systems
    - Promote a cyber security culture throughout the aviation sector and within national agencies
    - Establish policies for allocation of resources whenever required. Ensure security with

respect to data transfers, system architectures, confidentiality of data, system monitoring, etc.

- Develop ICAO's cybersecurity framework. Establish coordination and cooperation between various areas. Develop a horizontal, cross-cutting and functional approach involving air navigation, communication, surveillance, and other crucial disciplines.

ICAO's Aviation Cyber Security Strategy aligns with ICAO activities concerned with cyber security. The strategy is supported by IATA and adopts a series of principles and actions. These measures and actions are contained in a framework built on seven pillars:

Civil Aviation Cyber Security Plan has been signed by ACI, ICAO, Civil Air Navigation Services Organization (CANSO) and IATA. It can be said to be a blueprint to describe commitments with time horizon, task and deliverables.

For example, if a commitment is to develop a common understanding of cyber threats and risks, it can be described as:

Commitment	Short Term (0–6 months)	Mid Term (6–12 months)	Long Term (12–18 months)
Develop a common understanding of cyber threats and risks	Task- Develop and provide input to common risk and threat matrices Deliverable- First draft input to threat and risk analysis	Deliverable- 2015 Aviation Security Panel Paper Deliverable- Input to ICAO working group on threat and risk and ECAC risk assessments	Task- Continue to review and communicate threats, update threat and risk analysis

Similarly, other commitments could be:

- Share assessment of risks
- Agree common language and terminology
- Develop joint positions and recommendations
- Present to the public a joint, consistent and coherent approach to management of cyber threats and risks.
- Promote cooperation among state-level appropriate authorities and industry to establish coordinated aviation cyber security strategies, policies and plans. defensive systems, as appropriate

Contribution of IATA to the same can be explained as:

- In the 40th ICAO Assembly, IATA presented the Information Paper- Aviation Cyber Security Moving Forward to explain the need for a proactive and coordinated approach to manage aviation cyber security risks
- IATA participated in the Second High- Level Conference on Aviation Security in November, 2018.

explore the challenges and discuss the measures that need to be taken.

An Aviation Cyber Security Training Program also takes place for a duration of 3 days to impart knowledge and training to aviation personnel to understand and manage cyber risks.

Thus, IATA always participates actively against cyber threats and engages with members, industry leaders and stakeholders to clearly communicate its role and vision in global aviation cyber security.

Summary

As per IATA, aviation cyber security is defined as cyber security relating to aircraft and airport operations. The aviation industry uses information technology and communication (ITC) systems extensively and the systems of the various stakeholders are interconnected for information sharing and control & coordination.

The Civil Aviation Cyber Security Plan has been signed by ACI, ICAO, Civil Air Navigation Services Organization (CANSO) and IATA. The plan serves as a road map to describe commitments with time horizon, task and deliverables. It needs to be understood, that like other prime sectors, the aviation sector too faces severe cyber threats and thus adequate measures must be taken to fight against cyber threats and risks.

Unit 14

Transportation of Dangerous Goods

Learning Objectives

By the end of this unit, you will be able to:

- Describe dangerous goods
- Understand hazard classes
- Explain technical instructions

Introduction

All those goods and items that can be a risk or threat to safety, life, property, or health come under the category of dangerous goods. In aviation sector, these include items that can hamper safety during their transportation.

Dangerous goods are transported and are carried regularly by air all over the world. But there are certain international standards that each State, under the provisions of the Chicago Convention, is required to introduce into national legislation regarding transportation of such items. The purpose is to maintain safety and security concerns.

The given unit gives about dangerous goods, hazard classes as determined by the United Nations Committee of Experts, and concerned technical instructions.

Dangerous Goods

The goods or items that can hamper safety and pose a risk to life, health, or property are dangerous goods.

Annex 18 deals with the Safe Transport of Dangerous Goods by Air and sets down broad principles (as per Annex 18) that States are required to abide by. It is the responsibility of States and concerned airport authorities to make sure that the goods specified as dangerous as per ICAO have to be carried in compliance with the stated requirements.

Annex 18 includes the following:

- Definitions of terms
- Applicability
- Classification
- Limitation on the transport of dangerous goods by air
- Packing
- Labelling and marking
- Shipper's responsibilities
- Operator's responsibilities
- Provision of information
- Establishment of training programs
- Compliance
- Dangerous goods accident and incident reporting
- Dangerous goods security provisions

More than fifty percent of cargo being carried by all modes of transport comprises of dangerous goods. These include explosives, flammable goods, radioactive goods, toxic items, etc. These goods need to be transported because of their numerous uses worldwide in almost all sectors.

Most of these goods are transported via airways. However, adequate precautions are taken for safe transport of these goods. Annex 18 along with the associated document Technical Instructions for the Safe Transport of Dangerous Goods by Air take care of the safe transportation of dangerous goods. Many other codes were also established for regulating the carriage of these goods, but these were not applicable globally and were not in sync with the corresponding rules of other transport modes.

Annex 18 specifies the broad Standards and Recommended Practices that need to be taken care of while carrying these goods. The provisions and technical instructions given in Annex 18 are binding upon Contracting States. However, the instructions are updated regularly due to the nature of goods being carried, developments in chemical, manufacturing and packaging industries, and other issues.

It was in the year 1976 when a panel of experts was established to define the ICAO requirements for dangerous goods. However, the panel keeps recommending changes in the technical restrictions. The technical restrictions are by and large kept in sync with the recommendations of the United Nations Committee of Experts on the Transport of Dangerous Goods and with the regulations of the International Atomic Energy Agency. This helps to establish a common base to define cargo to be carried safely by all means of transport, whether water, air, road, or rail.

ICAO initially identifies and describes a list of those substances which are unsafe to carry, and then, show how other potentially dangerous articles or substances can be transported safely.

Hazard Classes

The United Nations Committee of Experts defines nine hazard classes. These are used for all modes of transport. The classes can be specified as:

Class 1
Explosives of all kinds like fireworks, sporting ammunition, etc

Class 2
Compressed or liquefied gases like oxygen cylinders, refrigerated liquid nitrogen etc. These include toxic as well as flammable

Class 3
Flammable liquids including gasoline, lacquers, paint thinners, etc

Class 4
Flammable solids, spontaneously combustible materials and those materials which exit flammable gases after coming in contact with water. Examples include some powdered metals, cellulose type film and charcoal

Class 5
Oxidizing materials and also include organic peroxides which are both oxygen carriers and very combustible

Class 6
Toxic substances like pesticides, mercury compounds, etc. The group also includes infectious substances, which must sometimes be shipped for diagnostic or preventative purposes

Class 7
Radioactive isotopes and other radioactive elements. Radioactive isotopes are required for medical or research purposes, and also used in heart pacemakers and smoke detectors

Class 8
Corrosive substances which may be dangerous to humans and can also adversely affect the structure of an aircraft. Examples include caustic soda, battery fluid, paint remover, etc

Class 9
Miscellaneous items which can partially be dangerous, for example, magnetized materials which could affect the aircraft's navigational systems

Technical Instructions

It is expected of the contracting states to ICAO to abide by the ICAO requirements and legally recognize these. The provisions of Annex 18 are improved by the detailed specifications of the Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284).

Annex 18 mandates that "Each Contracting State shall take the necessary measures to achieve compliance with the detailed provisions contained in the Technical Instructions. Each Contracting State shall also take the necessary measures to achieve compliance with any amendment to the Technical Instructions, which may be published during the specified period of applicability of an edition of the Technical Instructions".

The technical instructions comprise of specific requirements and classify dangerous goods and list these goods. The list identifies goods that are:

- Forbidden under any circumstances
- Forbidden to be carried on passenger and cargo aircraft under usual conditions, but can be transported under special circumstances subject to exemption by the States concerned
- Forbidden to be carried on passenger aircraft, but can be carried on cargo aircraft under normal circumstances
- Permitted to be transported both on passenger as well as cargo aircraft under normal circumstances

The instructions also specify the packaging details, quantity to be packed per package according to the degree of hazard, methods of packing to be used, and the type of aircraft to be used (passenger or cargo). Usually, no restriction is levied on the number of packages per aircraft, but there are requirements for the markings and labels for packages and the documentation for consignments and strict testing regime must be followed.

The technical instructions mandate every package of dangerous goods to be inspected externally by the operator before carriage to confirm the fit and desired state and ensure that all requirements have

been duly met. Packages are subject to loading restrictions as well as segregation to restrict and prevent movement in flight.

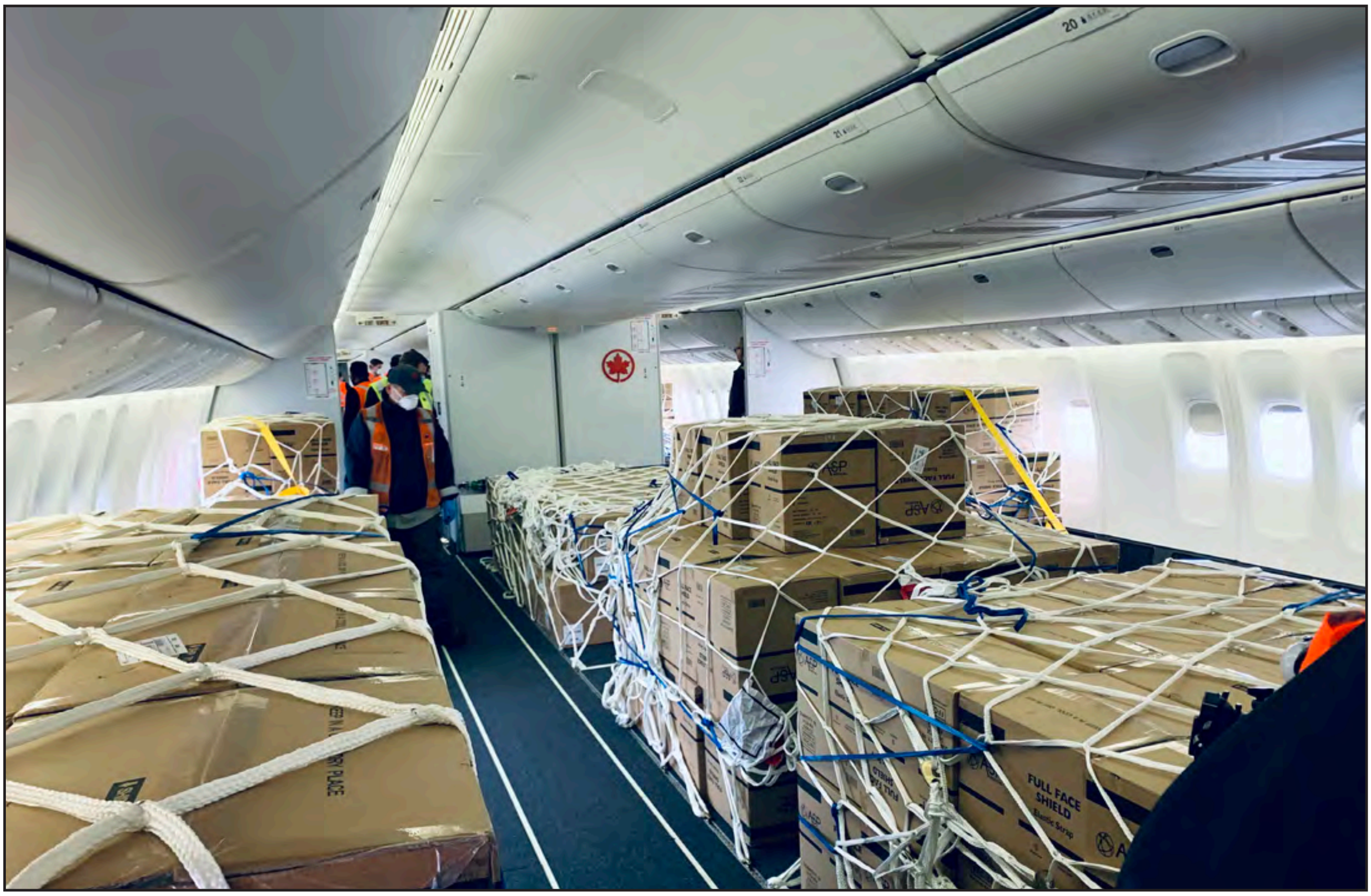
The pilot-in-command of an aircraft must be aware of the dangerous goods on-board and their location so that in case of any emergency, he/she can inform the appropriate air traffic services unit of what is on the aircraft to assist the emergency services in their response.

The technical instructions also provide the pilot-in-command to have a choice with respect to conveying information about dangerous goods. This is to prevent the pilot-in-command and/or the co-pilot to divert their attention from controlling the aircraft in emergency situations.

The airline operators are aware of the nature of dangerous goods boarded on their aircraft. In case of any mishappening, they must quickly inform the State in which the accident occurred about the type of goods and where were these located. The operators must also inform the concerned authorities about any accident or unpleasant incident. States at the same time have specified procedures to investigate such occurrences.

The technical instructions also specify the training requirements for all those who are involved in consigning, handling and carrying dangerous goods, and cargo and passenger baggage. It is essential to maintain training records and refresh training activities at two-year intervals.

The shippers and airline operators have specific responsibilities. The shippers have to ensure that all those responsible for preparing consignments of dangerous goods must be thoroughly trained to do so, else any other organization with trained



personnel is used. In the case of airline operators, they have to ensure training for their own staff and those of their handling agents. Training programs for operators are subject to approval by the authority.

Extract from Technical Instruction Showing the Dangerous Goods List

- **Column 1:** Name of the item
- **Column 2:** UN Number- the serial number assigned to the article or substance under the United Nations classification system
- **Column 3:** Class explained in this chapter in the beginning
- **Column 4:** Subsidiary risk- the class or division number of any important subsidiary risks
- **Column 5:** Labels- the class hazard label followed by the subsidiary risk label(s)
- **Column 6:** State variations
- **Column 7:** Special provisions–a number referring to the appropriate entries shown in another table
- **Column 8:** UN packing group–UN packing group number (i.e., I, II or III) assigned to the article or substance
- **Column 9:** Excepted Quantities–an alphanumeric code which indicates the maximum quantity per inner and outer packaging for transporting dangerous goods as excepted quantities in accordance with details provided in this document
- **Column 10:** Passenger aircraft–Packing instruction
- **Column 11:** Passenger aircraft–Maximum net quantity per package
- **Column 12:** Cargo aircraft–Packing instruction
- **Column 13:** "Cargo aircraft–Maximum net quantity per package

Given below is a description of a few dangerous goods to depict if these are allowed in passenger/cargo aircraft:

Name	UN No.	Class or Division	Sub-sidiary risk	Labels	State varia-tions	Special provi-sion	UN packing group	Excep-ted quantity	Passenger aircraft		Cargo aircraft	
									Packing instruction	Max.net quantity per package	Packing instru-ction	Max.net quantity per package
1	2	3	4	5	6	7	8	9	10	11	12	13
Accumulators, electric, see Batteries, etc. (UN Nos. 2794, 2795, 2800, 3028, 3292)					AU 1 CA 7 GB 3							
Acetal	1088	3		Liquid flammable	IR 3 NL T	A1	II	E2	305 Y305	5 L 1 L	307	60 L
Acetaldehyde	1089	3		Liquid flammable	US 3		I	E0	FORBIDDEN		304	30 L

As seen, Acetaldehyde is not allowed in passenger aircraft, but permitted in cargo aircraft.

Acetone cyanohydrin, stabilized	1541	6.1			AU 1 CA 7 GB 3 IR 3 NL 1 US 3 US 4	A2			FORBIDDEN		FORBIDDEN	

Likewise, the commodity mentioned as Acetone cyanohydrin, stabilized is prohibited in both passenger aircraft and cargo aircraft.

Talking about India, DGCA / India is the regulatory authority for the transportation of dangerous goods by air. The Aircraft (Carriage of Dangerous Goods) Rules, 2003 is very specific to India. DGCA has published CARs for approval of dangerous goods training program, Guidelines and Procedure for Dangerous Goods Inspections, Grant of approval to carry dangerous goods by air and Secondment of Dangerous Goods Inspectors.

Summary

- All those goods and items that can be a risk or threat to safety, life, property, or health come under the category of dangerous goods. In aviation sector, these include items that can hamper safety during their transportation. Annex 18 deals with the Safe Transport of Dangerous Goods by Air and sets down broad principles, and the States must comply with these.
- The United Nations Committee of Experts defines nine hazard classes. These are used for all modes of transport.
- Talking about India, DGCA / India is the regulatory authority for the transportation of dangerous goods by air. The Aircraft (Carriage of Dangerous Goods) Rules, 2003 is very specific to India.

Unit 15

Safety and Security Audits

Learning Objectives

By the end of this unit, you will be able to:

- Discuss Universal Safety Oversight Audit Program - CMA
- Explain Continuous Monitoring Approach
- Describe Universal Security Audit Program Continuous Monitoring Approach
- Understand Line Operations Safety Audit

Introduction

Safety auditing is a core safety management activity, providing a means of identifying potential problems before they have an impact on safety. Safety auditing is an element of safety management that subjects the activities of airline operators/ service providers to a systematic critical evaluation. The aim is to disclose the strengths and weaknesses, identify areas of non-tolerable risk and devise rectification measures.

Universal Safety Oversight Audit Programme (USOAP)

It was in the year 1999 that ICAO's Universal Safety Oversight Audit Programme (USOAP) was launched.

USOAP assesses the capabilities of the states in providing safety and analyzing if the states are managing and effectively implementing the critical elements (CEs) of a safety oversight system or not.

Safety performance can be effective only when the concerned personnel is competent enough and adequately trained to ensure SARPs compliance. Thus, USOAP by ICAO is to audit the safety oversight capabilities of the State.

These audits help ICAO to assess Member States' safety oversight capabilities. Further, the result of these audits helps to generate a more comprehensive analysis of aviation safety concerning effectiveness and development.

These audits are tailored to the level of complexity of aviation activities in the State to be audited. Timings, the duration of audits, and the size and composition of the audit teams are determined through a review of the information submitted by the State.

As of Dec 2017, ICAO has audited 185 Member States, from both the Comprehensive Approach (CSA) and the Continuous Monitoring Approach (CMA) cycles representing 96% of all Member States responsible for the safety oversight for 99% of all international air traffic.

USOAP Comprehensive Systems Approach (CSA) includes safety-related provisions contained in all safety-related Annexes to the Chicago Convention.

Continuous Monitoring Approach (CMA)

CMA uses a web-based platform to monitor the safety oversight systems of states. The "Online Framework" (OLF) validates States' progress through various on-site and off-site validation activities. The platform also assesses the effectiveness and sustainability of States' safety oversight systems through audits. CMA proves cost-effective, dynamic, and flexible system for assessment.

The USOAP CMA will continue to evolve in the next few years, to support the efforts of states in implementing a State Safety Programme (SSP). In 2014, ICAO initially published "new Protocol Questions (PQs) on safety management". These were used for audits and other continuous monitoring activities conducted under the Universal Safety Oversight Audit Programme (USOAP) Continuous Monitoring Approach (CMA). These PQs help to conduct voluntary and confidential assessments of SSP implementation as requested by ICAO member States.

As per the new approach, the safety information system is ongoing that supplements the cyclical audits. Thus, the stakeholders get the latest information and can make decisions accordingly.

The eight audit areas of a member state's aviation system that the program monitors are:

1. Primary aviation legislation and associated civil aviation regulations
2. Civil aviation organizational structure
3. Personnel licensing activities
4. Aircraft operations
5. Airworthiness of civil aircraft
6. Aerodromes
7. Air navigation services
8. Accident and serious incident investigations

During an audit, ICAO may identify what is referred to as a 'Significant Safety Concern'. This helps the audited State to properly supervise its airlines, airports, and/or air navigation services provider under its jurisdiction. This however might not point out a particular loophole but will give an idea that the State is not meeting all safety concerns for the effective implementation of ICAO Standards. Further findings help to judge full technical details. The audited State also undertakes to regularly report to ICAO progress on the correction of the safety concern.

ICAO performs an ICAO Coordinated Validation Mission (ICVM) to determine if necessary actions have been taken to resolve previously identified safety deficiencies or not. Simply put, an ICVM as an

audit system acts as a follow-up activity to ensure the steps taken by the member states concerning safety and progress made in this direction.

Universal Security Audit Programme Continuous Monitoring Approach (USAP-CMA)

Another security audit program introduced by ICAO is called USAP. It is similar to the Safety Audit program of ICAO. CMA involves continuous monitoring hence; the program is called USAP-CMA. The program ensures continuous auditing and monitoring of Member States' aviation security performance to promote global aviation security. It also aims to enhance aviation security compliance and oversight capabilities by:

- Regularly analysis of data on Member States' aviation security performance, covering the level of implementation of the critical elements of an aviation security oversight system and the extent to which it complies with Standards of Annex 17 - Security and the relevant security-related Standards of Annex 9 Facilitation, associated procedures, guidelines, and security-related practices.
- Identifying deficits in the overall aviation security performance of the Member States and comprehensive evaluation of the risks that can occur due to these shortages.
- Assisting Member States to deal with identified deficiencies.
- Appraising and validating corrective measures taken by Member States.
- Re-assessing the overall levels of Member States' aviation security performance achieved. The purpose is to improve and enhance the

capabilities of all member states in attaining safety.

There are eight critical elements to an effective State aviation security oversight system. These encompass the whole spectrum of civil aviation security activities.

The critical elements (CE) (similar to SSP) and their associated components are:

CE-1: Aviation Security Legislation

- To provide a comprehensive and effective legislative framework consistent with the environment and complexity of the State's civil aviation operations.
- To establish and implement Annex 17 Standards and relevant security-related Standards contained in other Annexes
- To implement the State's aviation security

requirements.

CE-2:Aviation Security Programmes and Regulations

- To provide adequate national-level programs and regulations to address national requirements emanating from aviation security legislation.
- To provide standardized implementation procedures, equipment, and infrastructures in conformance with Annex 17 Standards (and security-related provisions contained in other Annexes).

CE-3:State Appropriate Authority for Aviation Security and its Responsibilities

- Designation of an appropriate national authority for aviation security matters, supported by appropriate technical and non-technical personnel and the provision of adequate financial resources.
- The State's appropriate authority must have aviation security regulatory functions, objectives, and policies. It must develop and maintain an effective National Civil Aviation Security Program, National Civil Aviation Security Training Program, and National Civil Aviation Security Quality Control Program. It must also ensure the declaration and application of relevant regulations, the allocation of tasks, and the coordination of responsibilities between government agencies.

CE-4: Personnel Qualifications and Training

- To provide measures to meet the minimum knowledge and experience requirements for technical personnel performing State aviation security oversight and regulatory functions.
- Provision of appropriate training to the concerned staff members to maintain and enhance their

competence.

- Requirements for and provision of training to the aviation industry on the implementation of applicable aviation security requirements.

CE-5: Provision of Technical Guidance, Tools, and Security Critical Information

- Provision of necessary technical guidance, tools, and security-critical information to technical personnel so that they can perform security oversight functions as desired.
- Provision of technical guidance on the implementation of applicable regulations by the appropriate authority.

CE-6: Certification and Approval Obligations

- Implementation of processes and procedures so that personnel and organizations engaged in aviation security activity meet the established requirements before they are allowed to conduct the relevant activities like certification of screeners and the approval of security programs.

CE-7: Quality Control Obligations

- Processes like audits, inspections, surveys, and tests make sure that aviation security entities meet the established requirements and work efficiently to comply with the set levels. Continuous monitoring of the concerned personnel performing security oversight functions is also covered under audits and inspections.

CE-8: Resolution of Security Concerns

- Implementation of processes and procedures to deal with identified deficiencies, including the ability to:
    - Analyze security deficiencies.
    - Provide recommendations to prevent reoccurrence.

- ○ Track rectification.
- ○ Respond to acts of unlawful interference.
- Ensure the effective implementation of corrective actions and take enforcement action when appropriate.

Line Operations Safety Audit (LOSA)

LOSA is a program to manage human error. It is a critical organizational strategy that develops countermeasures to operational errors. LOSA is an organizational tool that not only identifies threats to aviation safety but also lessens the risks incurred by such threats. It also manages human error in operational contexts. LOSA provides a principled, data-driven approach to prioritize and implement actions to enhance safety.

Let us compare the incident investigation/accident investigation with LOSA. Investigation of an accident to understand human performance is a reactive strategy. It helps to understand human performance and define remedial strategies. However, in terms of human performance, accidents yield data that depicts actions and decisions that failed to achieve a successful compromise between production and protection.

Accident investigation concentrates on failures. LOSA advocates a better understanding of the success stories to check their implication as a part of remedial strategies. However, the contribution of accident investigation is in no way less. It remains the base point to uncover unanticipated failures in technology or rare but strange events. Accident investigation also provides a framework: if only normal operations were monitored, defining unsafe behaviors would be a task without a frame of reference. Therefore, a proper investigation helps to know how specific behaviors can combine with specific circumstances to generate unstable and likely catastrophic scenarios.

One of the reactive /proactive strategies is the incident investigation apart from training, safety audits, and Flight Data Recording. An incident investigation is a tool that gives information on operational human performance with the help of incident reporting. Incidents tell a more complete story about system safety than accidents do because they signal weaknesses within the overall system before the system breaks down.

It is believed that incidents precede accidents. A common understanding is that numerous incidents of one kind take place before an accident, and eventually an accident of the same kind occurs. Incident reporting cannot completely reveal the human contribution to successes or failures in aviation and how remedial strategies can be improved to enhance human performance, but it is certainly better than accident investigations to understand system performance. However, the challenge is about understanding the processes underlying human error rather than taking errors at face value.

To understand the mechanisms underlying errors in operational environments, defects in system performance taken through incident reporting should be considered as symptoms of mismatches at deeper layers of the system. These could be shortages in training systems, flawed person/technology interfaces, poorly designed procedures, corporate pressures, poor safety culture, etc. The value of the data generated by incident reporting systems lies in the early warning about areas of concern, but such data do not capture the concerns themselves.

LOSA is a proactive strategy. It focuses on proposing countermeasures against human error, and monitoring of normal line operations.

Periodic monitoring of routine flights is, essential as a proactive measure and indirectly involves measurement of all aspects of the system, allowing the identification of areas of strength and areas of potential risks. On the other hand, an incident investigation tries to fix the symptoms of problems, possibly serious, possibly not.

Accident investigations are conducted after an unfortunate happening has occurred. However, there is a need to adopt a positive measure to protect against accidents rather than simply regret.

Error is a normal component of human behavior and cannot be completely avoided, but can be minimized. The same holds for technology. There might be events when technical errors occur either due to malfunctioning or mishandling. Thus, errors will continue to be a factor in operational environments because it simply is the downside of human cognition. However, the issue arises due to negative consequences as a result of these errors. If the negative consequences of an error are caught before they produce damage, then the error is inconsequential. In operational contexts, errors that are caught in time do not produce negative consequences and therefore, for practical purposes, do not exist. Countermeasures to error, training activities should try to make these errors visible before they produce negative consequences. This is the essence of error management "human error is unavoidable but manageable". Thus, Error Management is at the heart of LOSA.

LOSA takes the help of an expert and highly trained observers to collect data about flight crew behavior and situational factors on "normal" flights. The audits are conducted under no-risk conditions; therefore, flight crews are not held accountable for their actions and the errors that are observed. During flights that are being audited, observers identify the probable safety threats and reasons for the same. They also observe how these threats are addressed and the errors being generated. Further, observations are made about the role of crew members in managing these errors; and specific behaviors that have been known to be associated with accidents and incidents.

LOSA is closely linked with Crew Resource Management (CRM) training. Since CRM is essentially error management training for operational personnel, data from LOSA form the basis for contemporary CRM training refocus and/or design, known as Threat and Error Management (TEM) training.

Data obtained from LOSA gives a clear picture of system operations. This picture acts as a guideline to plan strategies concerning safety, training, and operations. LOSA uses examples of superior performance as models for training so that training interventions can be reshaped and reinforced based on successful performance positive feedback. This is essentially required to prevent accidents and adverse incidents.

The initial research/project definition was a joint attempt between The University of Texas at Austin Human Factors Research Project and Continental Airlines, with funding provided by the Federal Aviation Administration (FAA). In 1999, ICAO endorsed LOSA as the primary tool to develop countermeasures to

human error in aviation operations and developed an operational partnership with The University of Texas at Austin and Continental Airlines.

ICAO acts as an enabling partner in the LOSA program and promotes LOSA internationally.

The full LOSA process, from planning and observer selection and training to data collection, analyses, and final report, can take between 6 and 12 months. LOSA is recommended every 3 years.

LOSA searches for system safety performance, its strengths, and weaknesses.

- Strengths (+): Thick, no-hole cheese slices/sections.
- Weaknesses (-): Location and hole sizes in the cheese.
- Measure: Flight crew Threat and Error Management (TEM) performance.
- Method: Jump seat observations in regular, normal flight operations.

Safety and Production

The compromise between production and safety is quite complex. Humans can however effectively apply the right mechanisms to successfully achieve this balance, hence, the extraordinary safety record of aviation.

However, there might be times and situations when humans Humans mismanage or do not assess tasks correctly. This can disrupt the balance which can further lead to safety breakdowns.

Understanding the human contribution to successes and failures in aviation can be better achieved by monitoring normal operations, rather than accidents and incidents.

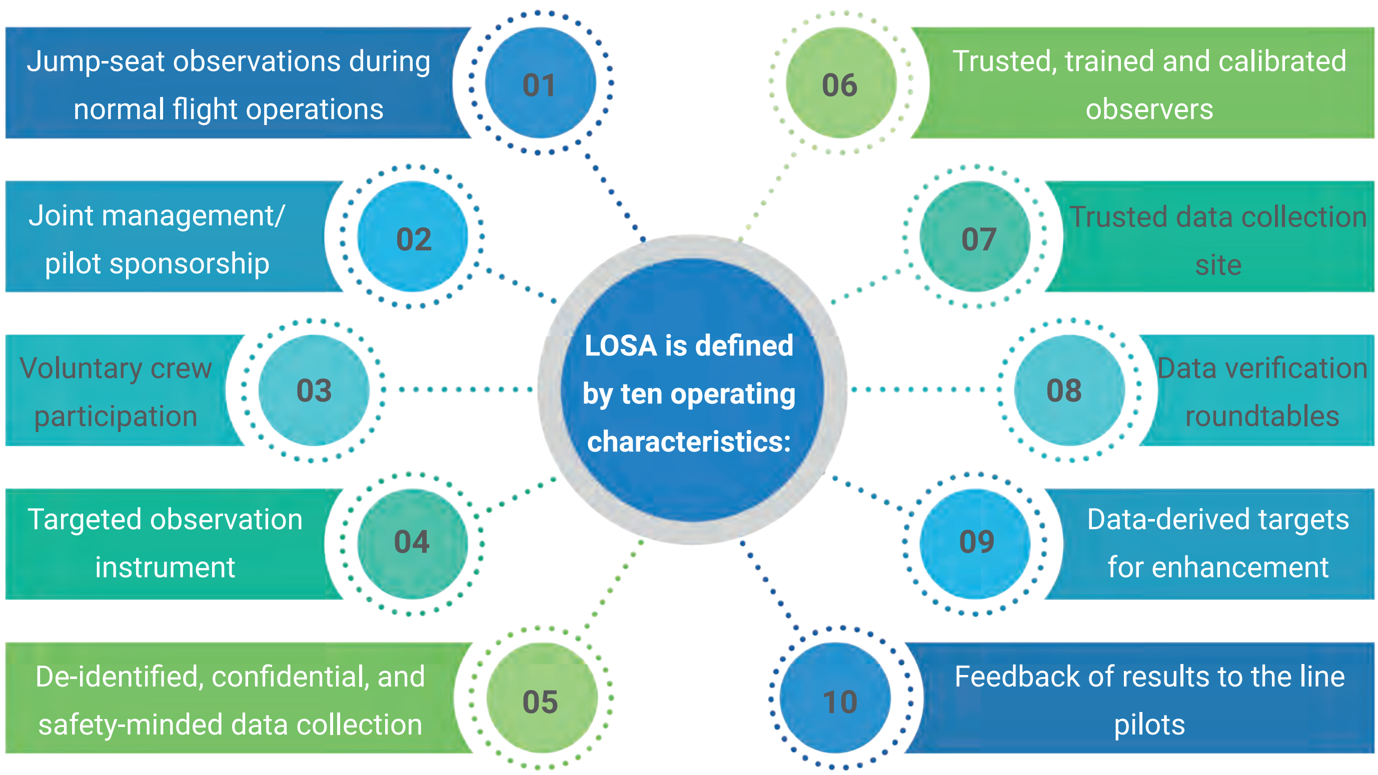
The Line Operations Safety Audit (LOSA) is the vehicle endorsed by ICAO to monitor normal operations.

Operating Characteristics of LOSA

LOSA is defined by ten operating characteristics:

- **Jump-seat observations during normal flight operations:** LOSA observations are limited to regularly scheduled flights.
- **Joint management/pilot sponsorship:** LOSA can be implemented effectively if both management and pilots (through their professional association, if it exists) support the project. The joint sponsorship will not only keep a check but also balance the project.
- **Voluntary crew participation:** If long-term success is desired, it is important to maintain the integrity of LOSA within an airline and the industry as a whole. This can be done by collecting all observations with voluntary crew participation. The quality of LOSA data depends upon on pilot's trust in the methodology and acceptance of the observer.

  Before conducting LOSA observations, an observer must take the permission of the crew members being observed. The crew has the option to decline, and no questions can be raised for the same. The observer simply approaches another flight crew on another flight and asks for their permission to be observed. If an airline receives an unreasonably high number of refusals by crews for LOSA to be conducted, it is an indication that the airline is facing trust issues and these are to be dealt with first.
- **Targeted observation instrument:** The current data collection tool to conduct a LOSA is the LOSA Observation Form. It is not critical that an airline use this form, but whatever data collection



instrument is used needs to target issues that affect flight crew performance in normal operations.

- **De-identified, confidential, and safety-minded data collection:** LOSA observers are asked not to record names, flight numbers, dates, or any other information that can identify a crew. In case this level of secrecy is not performed, disciplinary actions can be taken. LOSA has to collect safety data, and not punish pilots or other crew members. Airlines cannot lose a unique opportunity to get an insight into their operations by having pilots fearful that a LOSA observation could be used against them for disciplinary reasons.
- **Trusted, trained and calibrated observers:** Primarily, pilots conduct LOSAs. Observation teams will typically include line pilots, instructor pilots, safety pilots, management pilots, members of Human Factors groups, and representatives of the safety committee of the pilots' organization.

  There can be external observers also who are not affiliated with the airline. These observers can serve as an anchor point for the rest of the observers.

  The observers have to be trained and regulated to conduct They must be aware of the use of the LOSA rating forms and, particularly, the concepts of threat and error management.
- **Trusted data collection site:** Airlines must maintain confidentiality. Therefore, airlines must have a trusted data collection site. Currently, all observations are sent off-site directly to The University of Texas at Austin Human Factors Research Project, which manages the LOSA archives. This ensures that no individual

observations will be misplaced or improperly circulated through the airline.

- **Data verification roundtables:** Data-driven programs like LOSA require quality data management procedures and consistency checks. For LOSA, these checks are done at data verification roundtables. A roundtable consists of three or four department and pilots' association representatives who scan the raw data for inaccuracies.
- **Data-derived targets for enhancement:** The final product of a LOSA is the data-derived LOSA targets for enhancement. As the data are collected and analyzed, patterns emerge.

  Certain errors are quite frequent. Likewise, certain airports or events create more issues than others, certain SOPs are routinely ignored or modified, and certain exercises can be more difficult than others.

  LOSA identifies such patterns, and it is then up to the airline to develop strategies to implement necessary changes. After two or three years, the airline can re-conduct LOSA to check if the changes and other necessary adjustments have been fruitful or not.
- **Feedback of results to the line pilots:** After the completion of LOSA, the airline's management team and pilots' association must communicate LOSA results to the line pilots. Pilots wish to know the results as well as the plan of action and improvements as suggested. It has been seen that pilots usually welcome suggestions and implement the same if results are fed back in an appropriate manner.

Take Away from LOSA

LOSA observations indicated that 85 percent of errors committed were inconsequential. This depicts:

- The aviation system possesses very strong and effective defenses. LOSA data allows a principled and data-driven judgment of which defenses work and which do not, and how well defenses fulfill their role.
- Pilots intuitively develop Adhoc error management skills. So it is important to understand what pilots do well to promote safety through organizational interventions, such as improved training, procedures, or design, based on this "positive" data.

SUMMARY

Safety auditing is a core safety management activity, providing a means of identifying potential problems before they have an impact on safety. It was in the year 1999 that ICAO's Universal Safety Oversight Audit Programme (USOAP) was launched.

USOAP assesses the capabilities of the states in providing safety and analyzing if the states are managing and effectively implementing the critical elements (CEs) of a safety oversight system or not. As of Dec 2017, ICAO has audited 185 Member States, from both the Comprehensive Approach (CSA) and the Continuous Monitoring Approach (CMA) cycles representing 96% of all Member

States responsible for the safety oversight for 99% of all international air traffic.

USOAP Comprehensive Systems Approach (CSA) includes safety-related provisions contained in all safety-related Annexes to the Chicago Convention. CMA uses a web-based platform to monitor the safety oversight systems of states. The "Online Framework" (OLF) validates States' progress through various on-site and off-site validation activities.

Another security audit program introduced by ICAO is called USAP. It is similar to the Safety Audit program of ICAO.

LOSA is a program to manage human error. It is a critical organizational strategy that develops countermeasures to operational errors. LOSA is an organizational tool that not only identifies threats to aviation safety but also lessens the risks incurred by such threats. LOSA is closely linked with Crew Resource Management (CRM) training. Since CRM is essentially error management training for operational personnel, data from LOSA form the basis for contemporary CRM training refocus and/or design, known as Threat and Error Management (TEM) training.

Unit 16

Security Audits

Learning Objectives

By the end of this unit, you will be able to:

- Examine IATA Operational Safety Audit (IOSA)
- Describe sources for IOSA Standards and Recommended Practices (ISARPs)
- Discuss management commitment and auditor actions

Introduction

IOSA is an evaluation and assessment system that helps assess an airline's operational management and control systems. It is internationally recognized and conducts audits in a structured and standardized manner.

The given unit gives a brief description of IOSA and ISARPs.

IATA Operational Safety Audit (IOSA)

IOSA is an evaluation system to assess an airline's operational and control systems. IOSA is approved and recognized globally. It is a standardized procedure that is accepted worldwide. The IOSA audit system prevents redundancy in audits and proves cost-effective for IOSA-

participating airlines. All IATA members are IOSA registered and have to remain so to continue with IATA membership.

IOSA is recognized globally. As per the figures obtained for December 2018, there were 432 airlines on the IOSA registry, out of which 139 were non-IATA members. Thus, non-IATA member airlines also participate in the IOSA. During the year 2018, over 1,400 IOSA Audit Reports were exchanged, which is an increase of 7% from the previous year.

IATA in its safety reports for 2018 mentions that Airlines on the IATA Operational Safety Audit (IOSA) performed better than those that were not on the registry. The IATA Operational Safety Audit (IOSA) program reduces the burden on the industry by representing a global standard that is utilized by numerous regulators to complement their oversight activities on commercial operators.

Benefits for Airlines and Regulators

The IOSA Standards Manual (ISM) published by IOSA provides IOSA standards, recommended practices (ISARPs), associated guidance material, and other supporting information. This prepares the organizations for audit purposes. ISM also facilitates a uniform audit of the airlines since it is ISM used as the source of assessment criteria to be utilized by auditors when conducting an audit against the ISARPs. The ISM also helps an operator to structure its operational management and control systems in conformity with the latest industry operational practices.

The ISM is organized as follows:

SECTION 1
Organization and Management System (ORG)

SECTION 2
Flight Operations (FLT)

SECTION 3
Operational Control and Flight Dispatch (DSP)

SECTION 4
Aircraft Engineering and Maintenance (MNT)

SECTION 5
Cabin Operations (CAB)

SECTION 6
Ground Handling Operations (GRH)

SECTION 7
Cargo Operations (CGO)

SECTION 8
Security Management (SEC)

Sources for IOSA Standards and Recommended Practices (ISARPs)

The safety and security requirements published in the Annexes to the Convention on International Civil Aviation (ICAO Annexes) are the primary sources for specifications contained in the ISARPs. Safety and security requirements in the ICAO Annexes used as the basis for ISARPs are applicable directly or indirectly to the air operator.

Management Commitment

The Operator shall have a corporate safety policy that:

- Reflects the organizational commitment regarding safety, including the promotion of a positive safety culture.

- Includes a statement about the provision of the necessary resources for the implementation of the safety policy
- Is communicated throughout the organization.
- Is periodically reviewed to ensure continued relevance to the organization

Auditor Actions

- Identified/Assessed corporate safety policy
- Interviewed SMS manager and/or designated management representative
- Examined examples of corporate communication: Coordinated to verify communication of safety policy in all operational areas.
- Other Actions (Specify).

Summary

IOSA is an evaluation system to assess an airline's operational and control systems. IOSA is approved and recognized globally. The IOSA audit system prevents redundancy in audits and proves cost-effective for IOSA-participating airlines.

The safety and security requirements published in the Annexes to the Convention on International Civil Aviation (ICAO Annexes) are the primary sources for specifications contained in the ISARPs.