Safety Management Systems (SMS) Course

Module N° 2 – Basic safety concepts

Building an SMS

Safety
Management
System

Module 10
Phased approach to
SMS Implementation

Module 8
SMS planning

Module 9
SMS operation

Module 5
Risks

Module 6
SMS regulation

Module 7
Introduction to SMS

Module 1
SMS course
introduction

Module 2
Basic safety
concepts

Module 3
Introduction
to safety
management
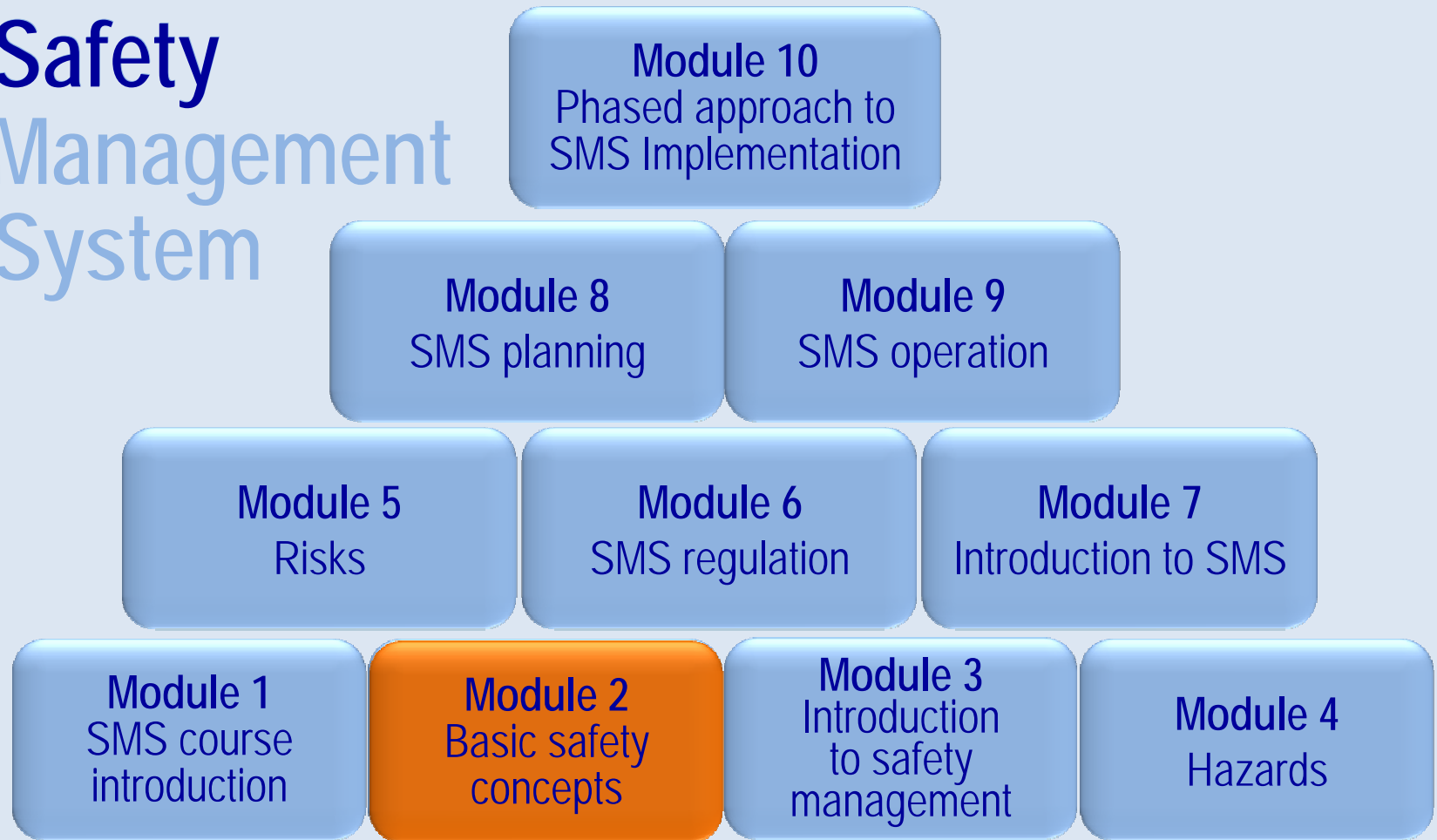
Module 4
Hazards

Objective

❖ *At the end of this module, participants will be able to explain the strengths and weaknesses of traditional methods to manage safety, and describe new perspectives and methods for managing safety.*

Outline

❖ Concept of safety

❖ The evolution of safety thinking

❖ A concept of accident causation – Reason model

❖ The organizational accident

❖ People, context and safety – SHEL(L) model

❖ Errors and violations

❖ Organizational culture

❖ Safety investigation

❖ Questions and answers

❖ Points to remember

❖ Exercise Nº 02/01 – *The Anytown City Airport accident (See Handout N° 1)*

Concept of safety

❖ **What is safety**

  ➢ Zero accidents (or serious incidents)?

  ➢ Freedom from danger or risks?

  ➢ Error avoidance

  ➢ Regulatory compliance?

  ➢ … ?

Concept of safety

❖ **Consider (*the weaknesses in the notion of perfection*)**

➢ The elimination of accidents (and serious incidents) is unachievable.

➢ Failures will occur, in spite of the most accomplished prevention efforts.

➢ No human endeavour or human-made system can be free from risk and error.

➢ **Controlled** risk and **controlled** error is acceptable in an inherently safe system.

Concept of safety (Doc 9859)

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

Safety

❖ **Traditional approach – Preventing accidents**

  ➢ Focus on outcomes (causes)

  ➢ Unsafe acts by operational personnel

  ➢ Attach blame/punish for failures to "perform safely"

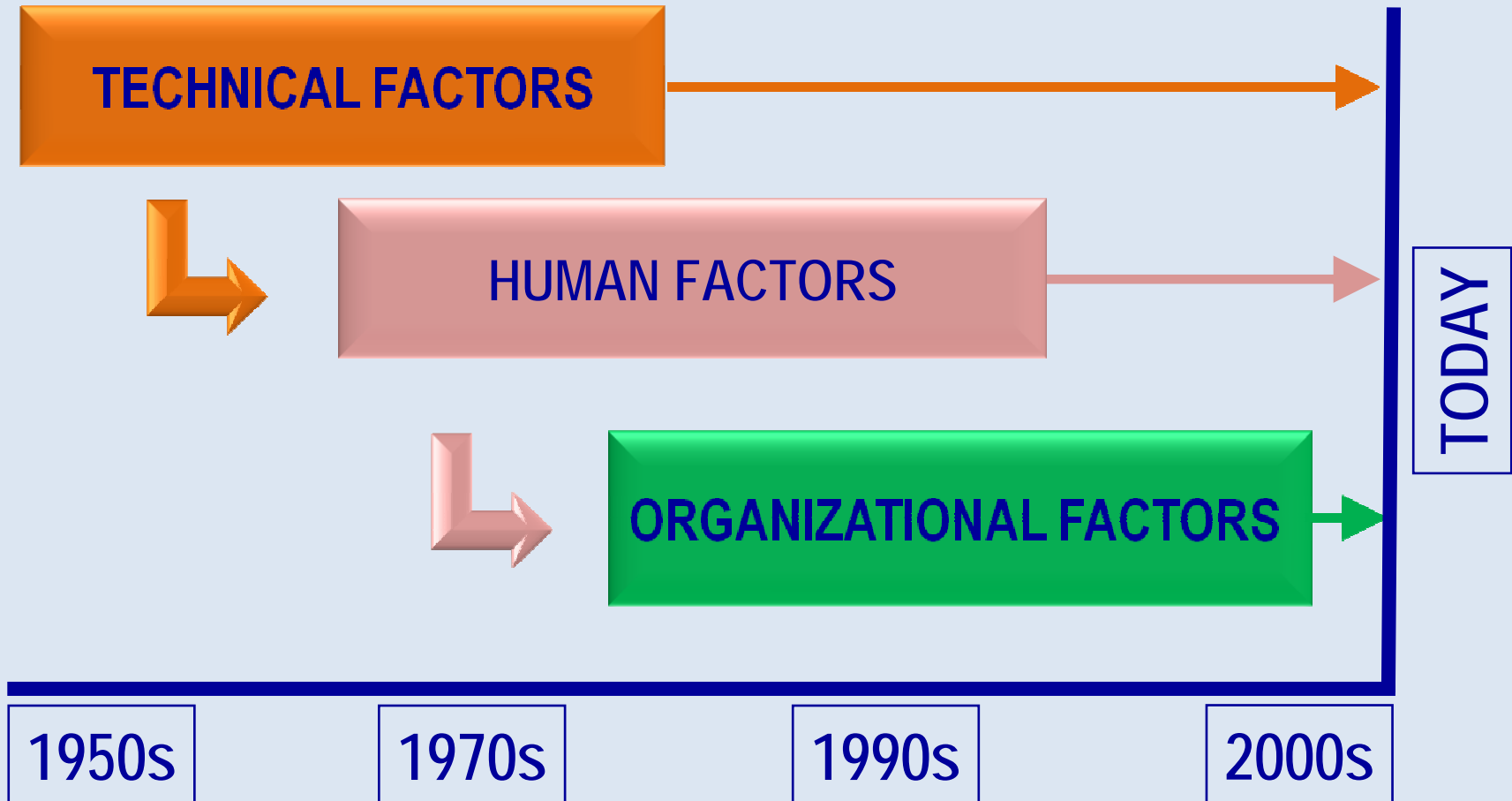 ➢ Address identified safety concern exclusively

  ➢ Identifies:

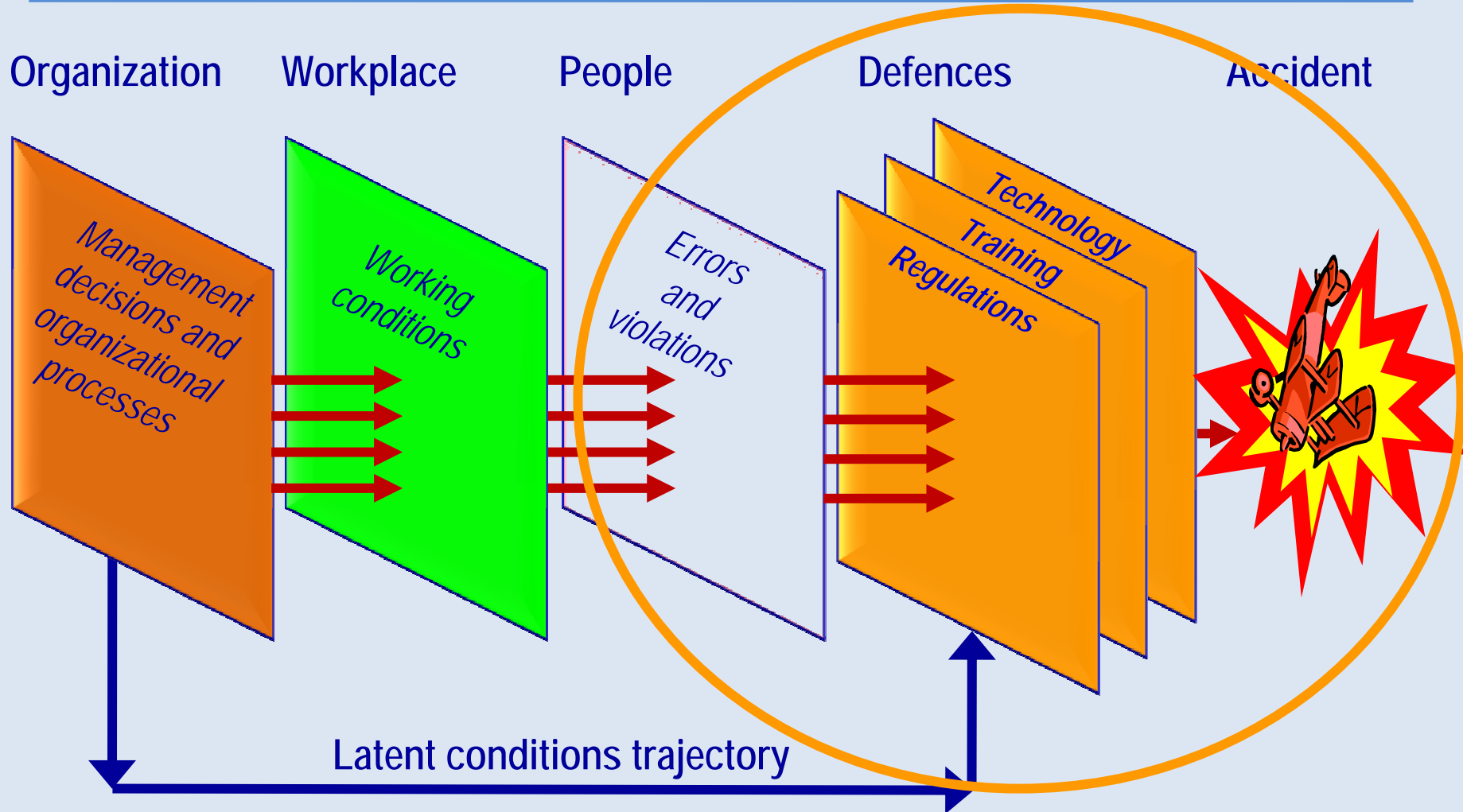| WHAT? | WHO? | WHEN? |

❖ But not always discloses:

| WHY? | HOW? |

The evolution of safety thinking

TECHNICAL FACTORS

HUMAN FACTORS

ORGANIZATIONAL FACTORS

TODAY

1950s 1970s 1990s 2000s

A concept of accident causation

Organization   Workplace   People   Defences   Accident

Management decisions and organizational processes

Working conditions

Errors and violations

Technology

Training

Regulations

Latent conditions trajectory

Source: James Reason

The organizational accident

Organizational processes

Workplace conditions

Active failures

➢ Policy-making
➢ Planning
➢ Communication
➢ Allocation of resources
➢ Supervision
➢ ...

Latent conditions

Defences

Activities over which any organization has a reasonable degree of direct control

The organizational accident

Organizational processes

Workplace conditions

Active failures

➤ Inadequate hazard identification and risk management
➤ Normalization of deviance

Latent conditions

Defences

Conditions present in the system before the accident, made evident by triggering factors.
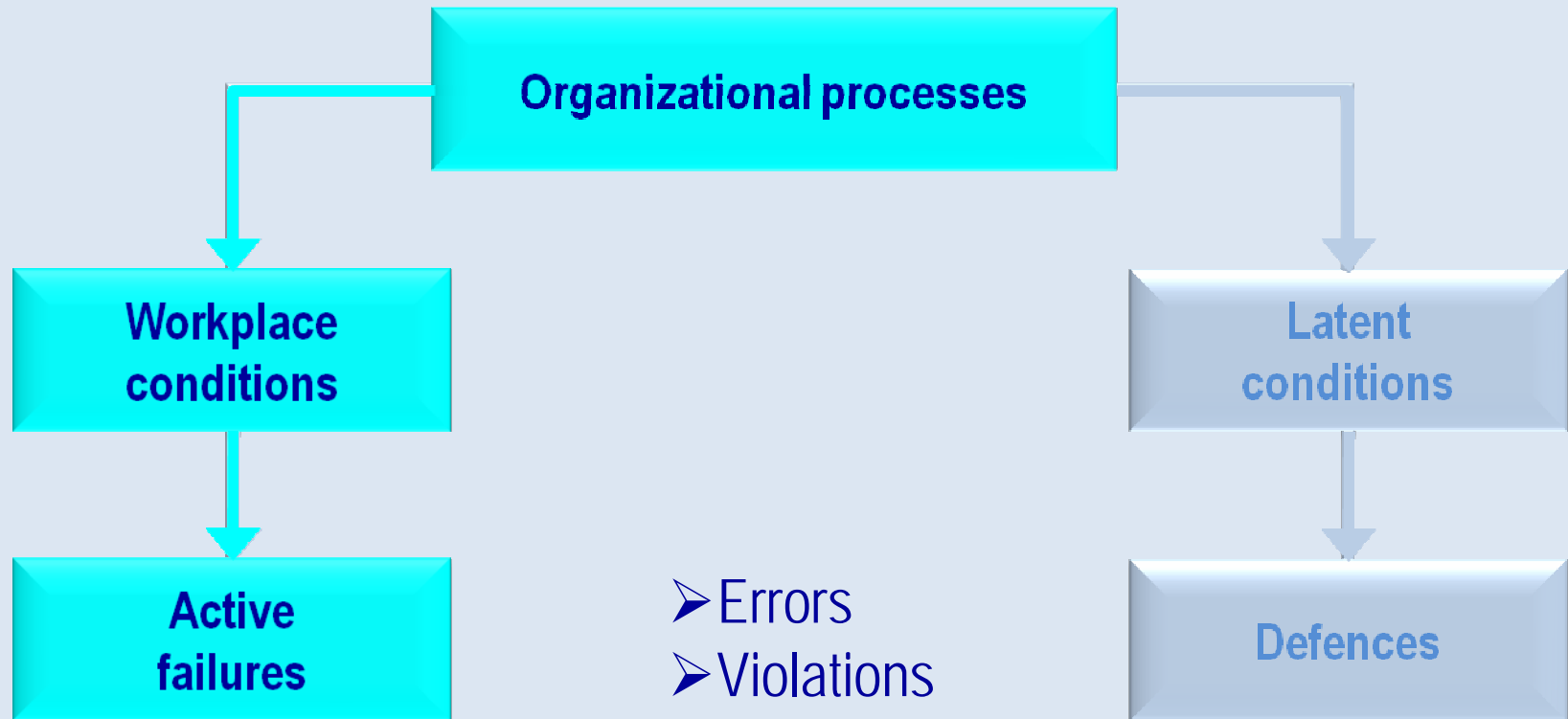
The organizational accident

Organizational processes

Workplace conditions

Active failures

Latent conditions

Defences

➢Technology
➢Training
➢Regulations

Resources to protect against the risks that organizations involved in production activities generate and must control.
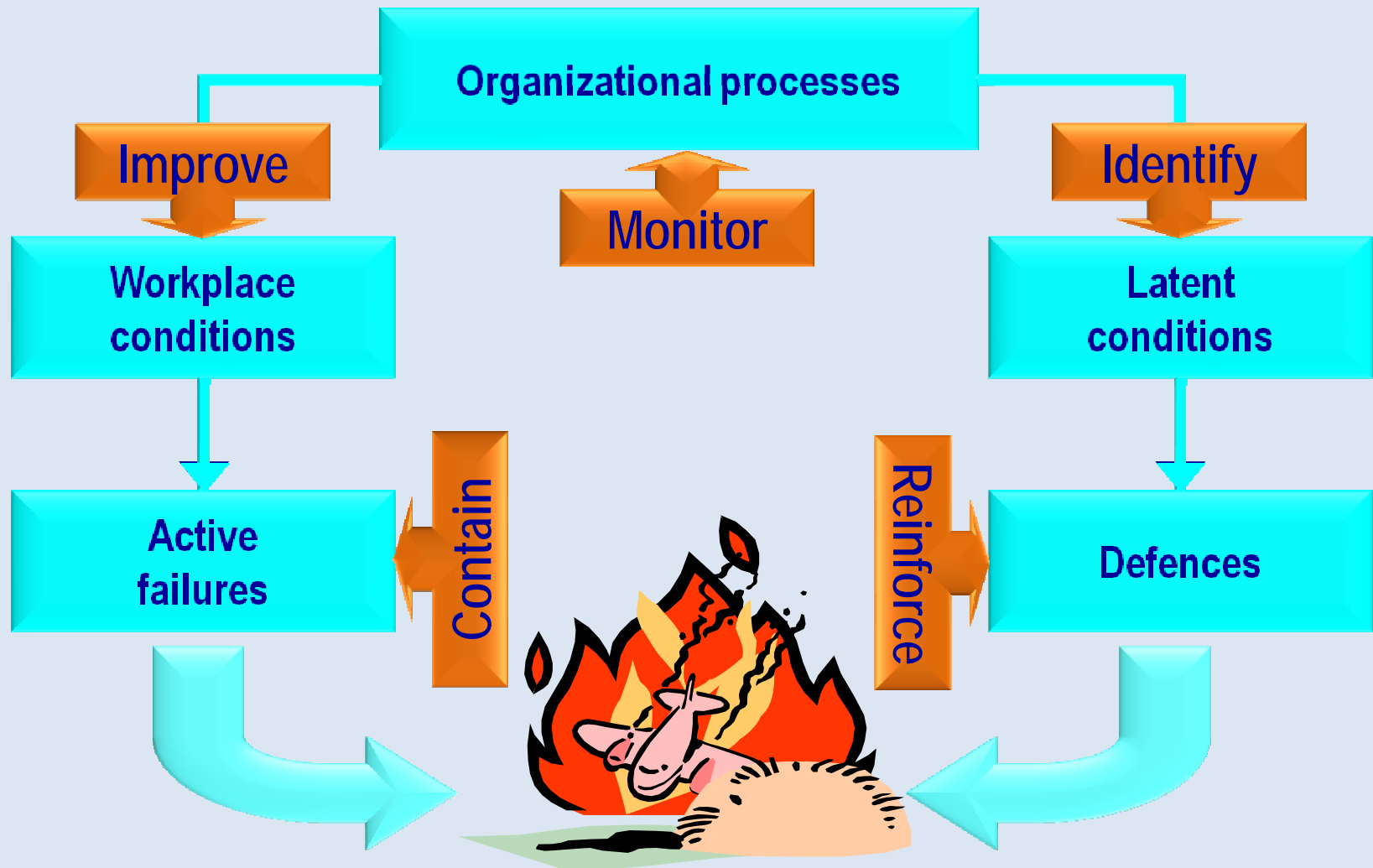
The organizational accident

Organizational processes

Workplace conditions

Active failures

Latent conditions

Defences

- ➢ Workforce stability
- ➢ Qualifications and experience
- ➢ Morale
- ➢ Credibility
- ➢ Ergonomics
- ➢ …

Factors that directly influence the efficiency of people in aviation workplaces.

The organizational accident

Organizational processes

Workplace conditions

Latent conditions

Active failures

➤ Errors
➤ Violations

Defences

Actions or inactions by people (pilots, controllers, maintenance engineers, aerodrome staff, etc.) that have an immediate adverse effect.

The organizational accident

Organizational processes

Improve

Monitor

Identify

Workplace conditions

Latent conditions

Active failures

Contain

Reinforce

Defences

People and safety

❖ Aviation workplaces involve complex interrelationships among its many components.

❖ To understand operational performance, we must understand how it may be affected by the interrelationships among the various components of the aviation work places.
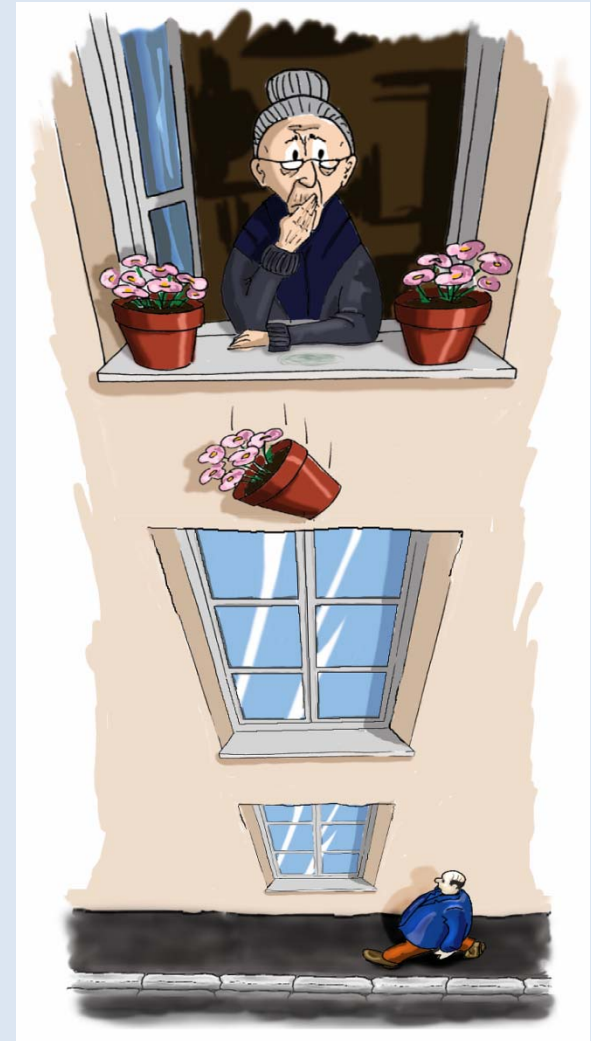
A

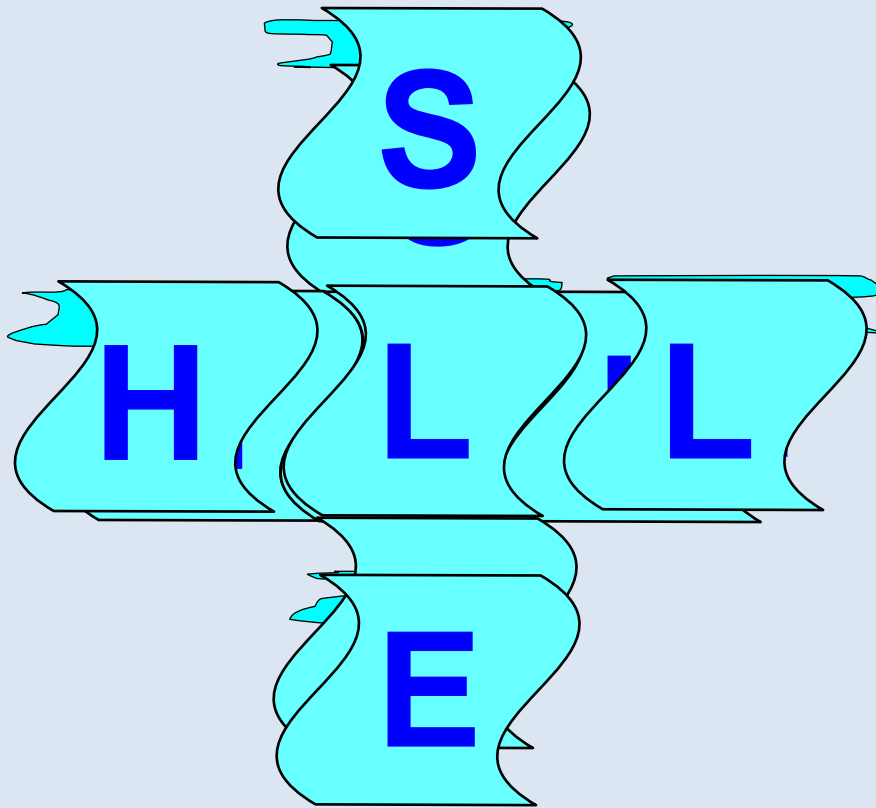**Understand human performance within the operational context where it takes place**

B

Processes and outcomes

Causes and consequences of operational errors are not linear in their magnitude

The SHEL(L) model

Understanding the relationship between people and operational contexts


- ❖ **S**oftware
- ❖ **H**ardware
- ❖ **E**nvironment
- ❖ **L**iveware
- ❖ **L**iveware, other persons

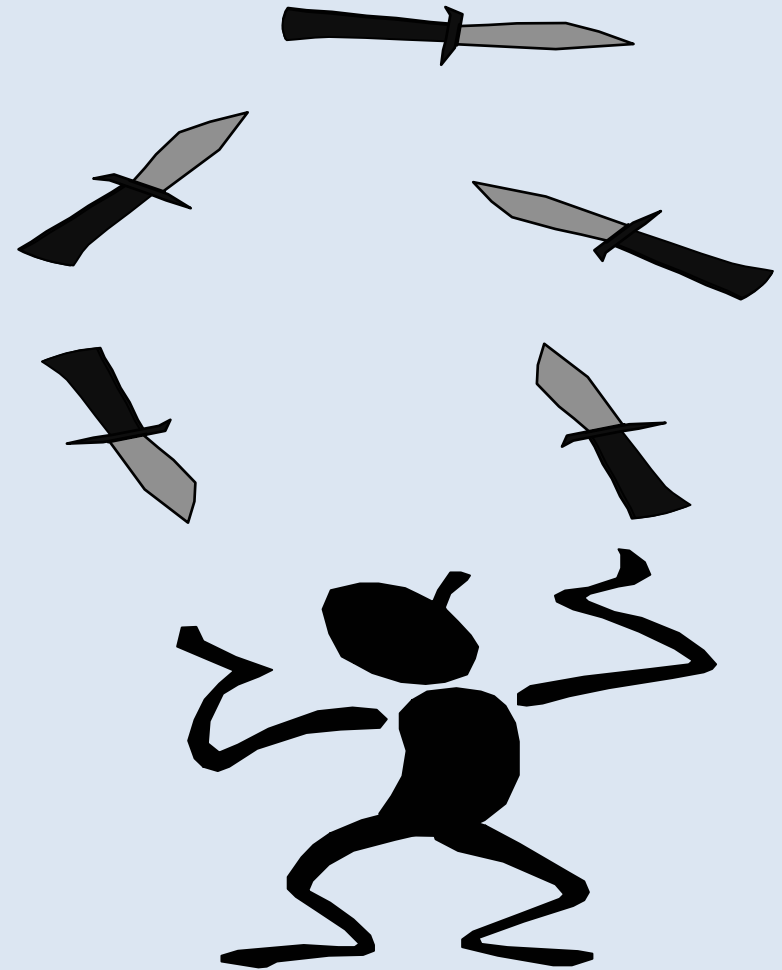# Operational performance and technology

❖ In production-intensive industries like contemporary aviation, technology is essential.

❖ As a result of the massive introduction of technology, the operational consequences of the interactions between people and technology are often overlooked, leading to **human error.**
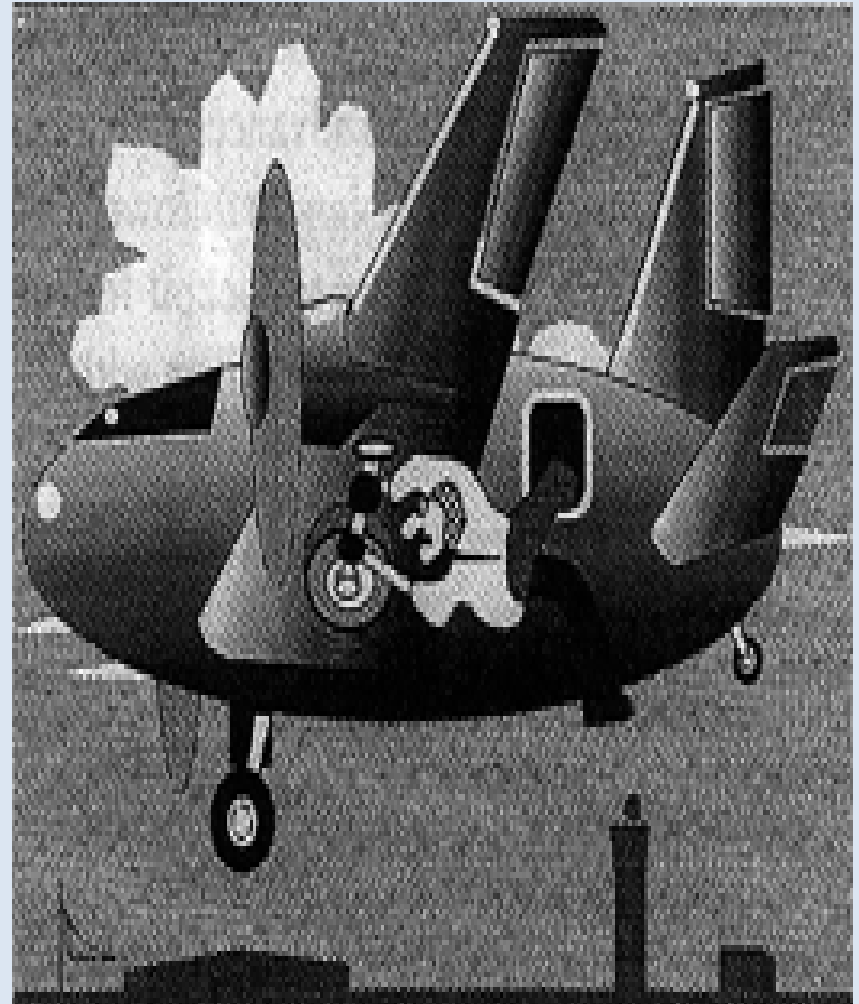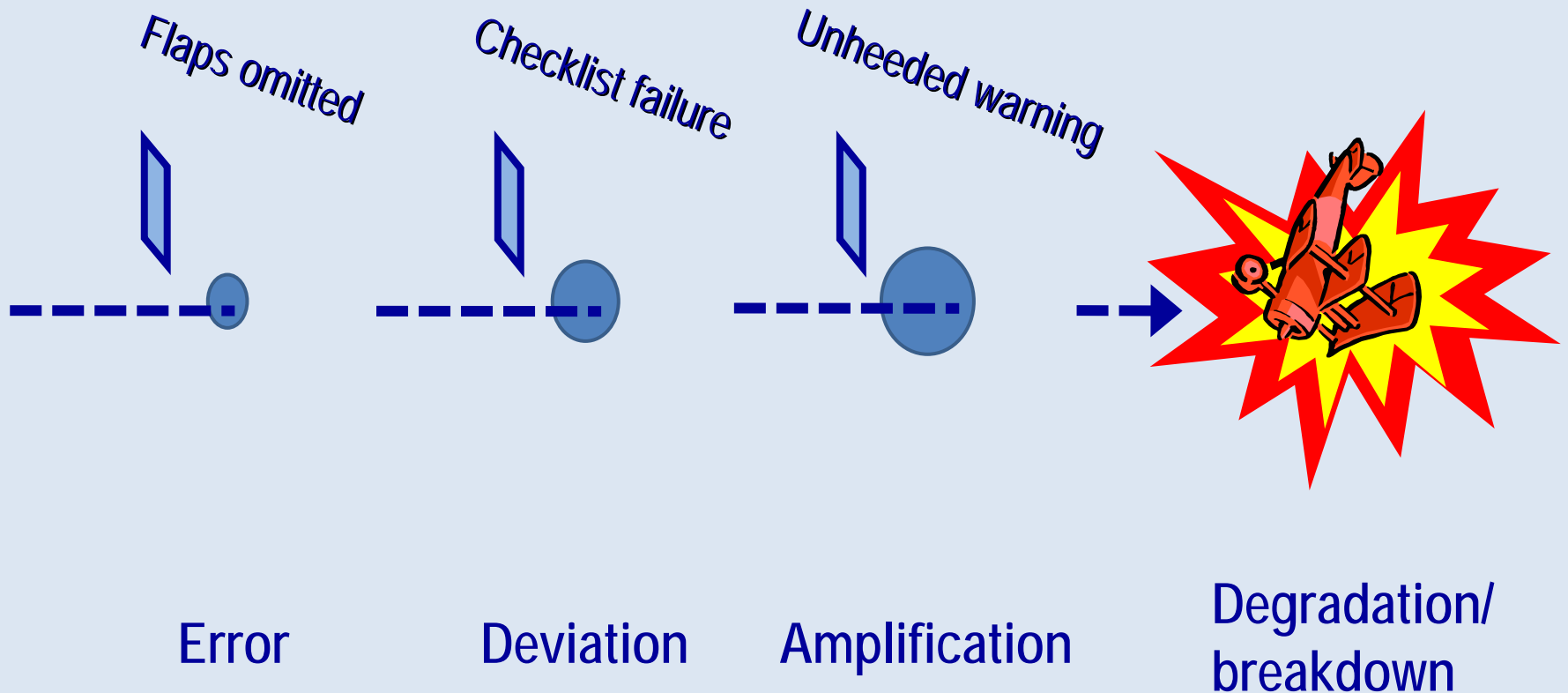
Understanding operational errors

❖ Human error is considered contributing factor in most aviation occurrences.

❖ Even competent personnel commit errors.

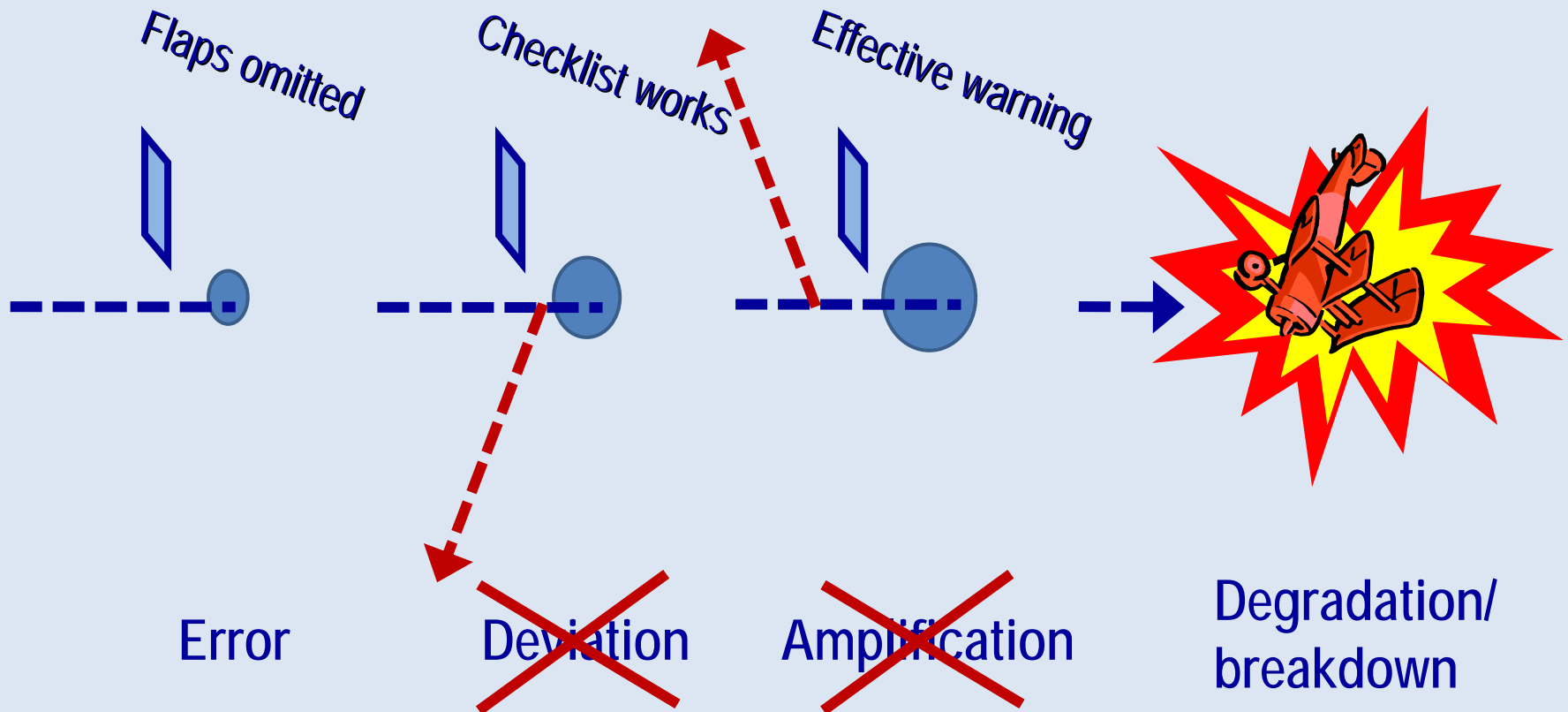❖ Errors must be accepted as a normal component of any system where humans and technology interact.

Errors and safety – A non linear relationship

Statistically, millions of operational errors are made before a major safety breakdown occurs

Accident investigation – Once in a million flights

Flaps omitted

Checklist failure

Unheeded warning

Error   Deviation   Amplification   Degradation/
breakdown

Safety management – On almost every flight

Flaps omitted

Checklist works

Effective warning

Error

Deviation

Amplification

Degradation/ breakdown

Three strategies for the control of human error

❖ Error **reduction** strategies intervene at the source of the error by reducing or eliminating the contributing factors.

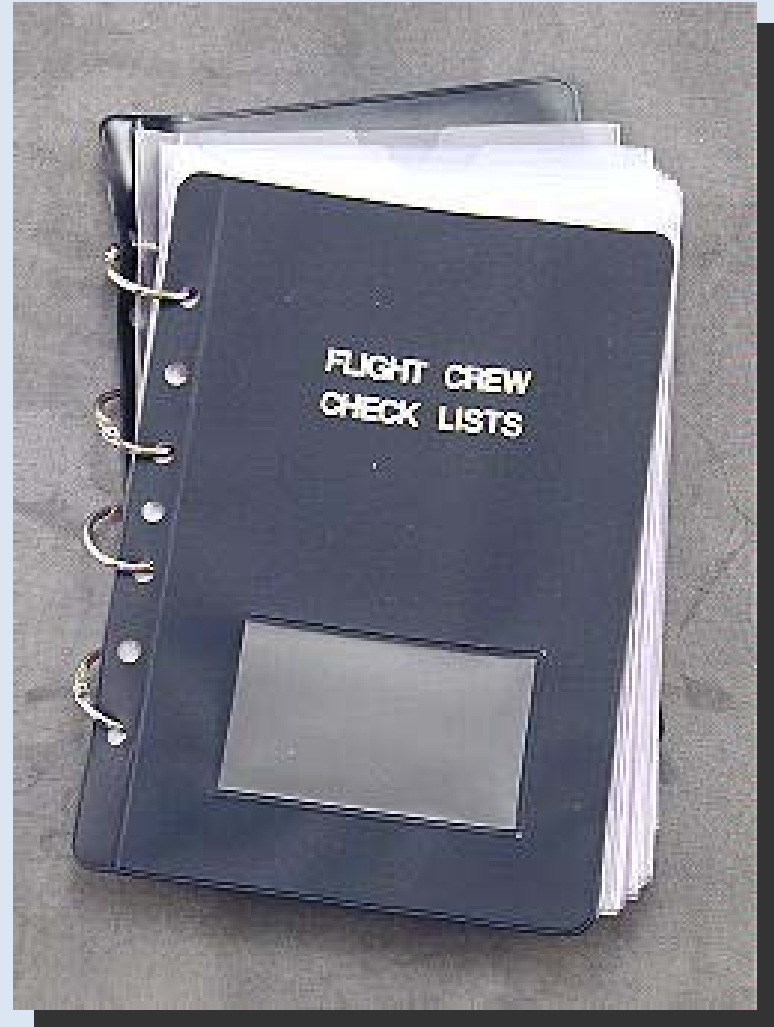➢ *Human-centred design*

➢ *Ergonomic factors*

➢ *Training*

➢ *…*

Three strategies for the control of human error

❖ Error **capturing** strategies intervene once the error has already been made, capturing the error before it generates adverse consequences.

➢ *Checklists*

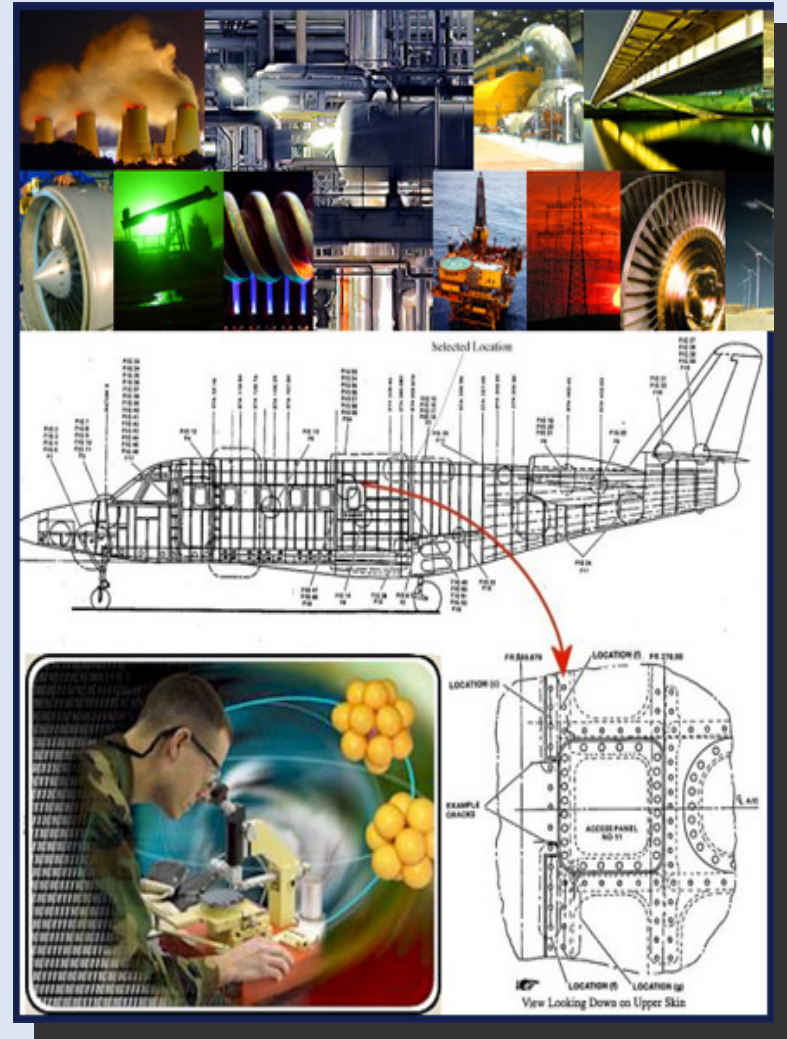➢ *Task cards*

➢ *Flight strips*

➢ *…*

Three strategies for the control of human error

❖ Error **tolerance** strategies intervene to increase the ability of a system to accept errors without serious consequence.

➢ *System redundancies*

➢ *Structural inspections*

➢ *…*

Understanding violations – Are we ready?
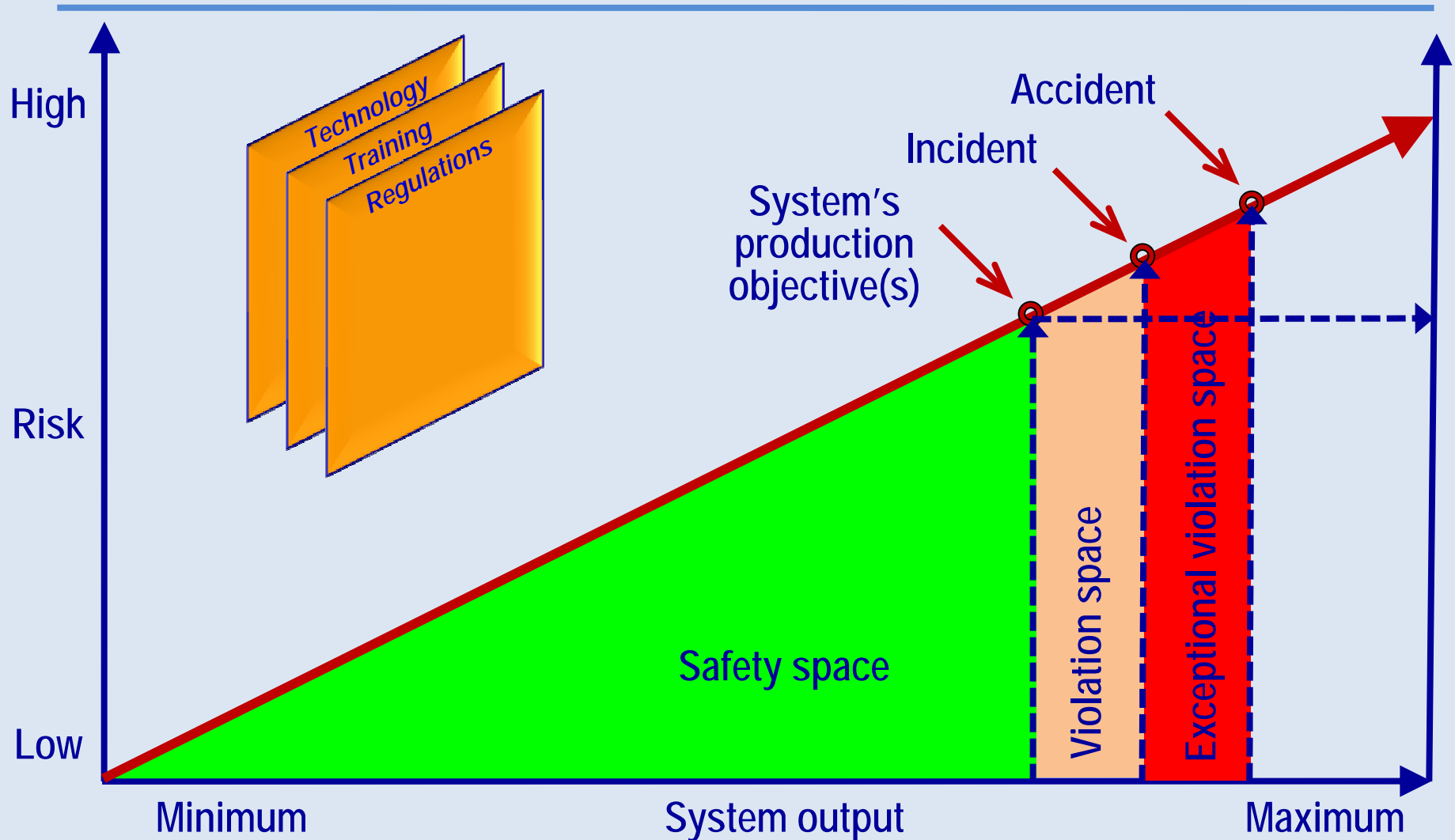
Culture

❖ Culture binds people together as members of groups and provides clues as to how to behave in both normal and unusual situations.

❖ Culture influences the values, beliefs and behaviours that people share with other members of various social groups.

Three cultures

National

Organizational

National

Professional

Three distinct cultures

❖ **National culture** encompasses the value system of particular nations.

❖ **Organizational/corporate culture** differentiates the values and behaviours of particular organizations (e.g. government vs. private organizations).

❖ **Professional culture** differentiates the values and behaviours of particular professional groups (e.g. pilots, air traffic controllers, maintenance engineers, aerodrome staff, etc.).

❖ No human endeavour is culture-free

Organizational/corporate culture
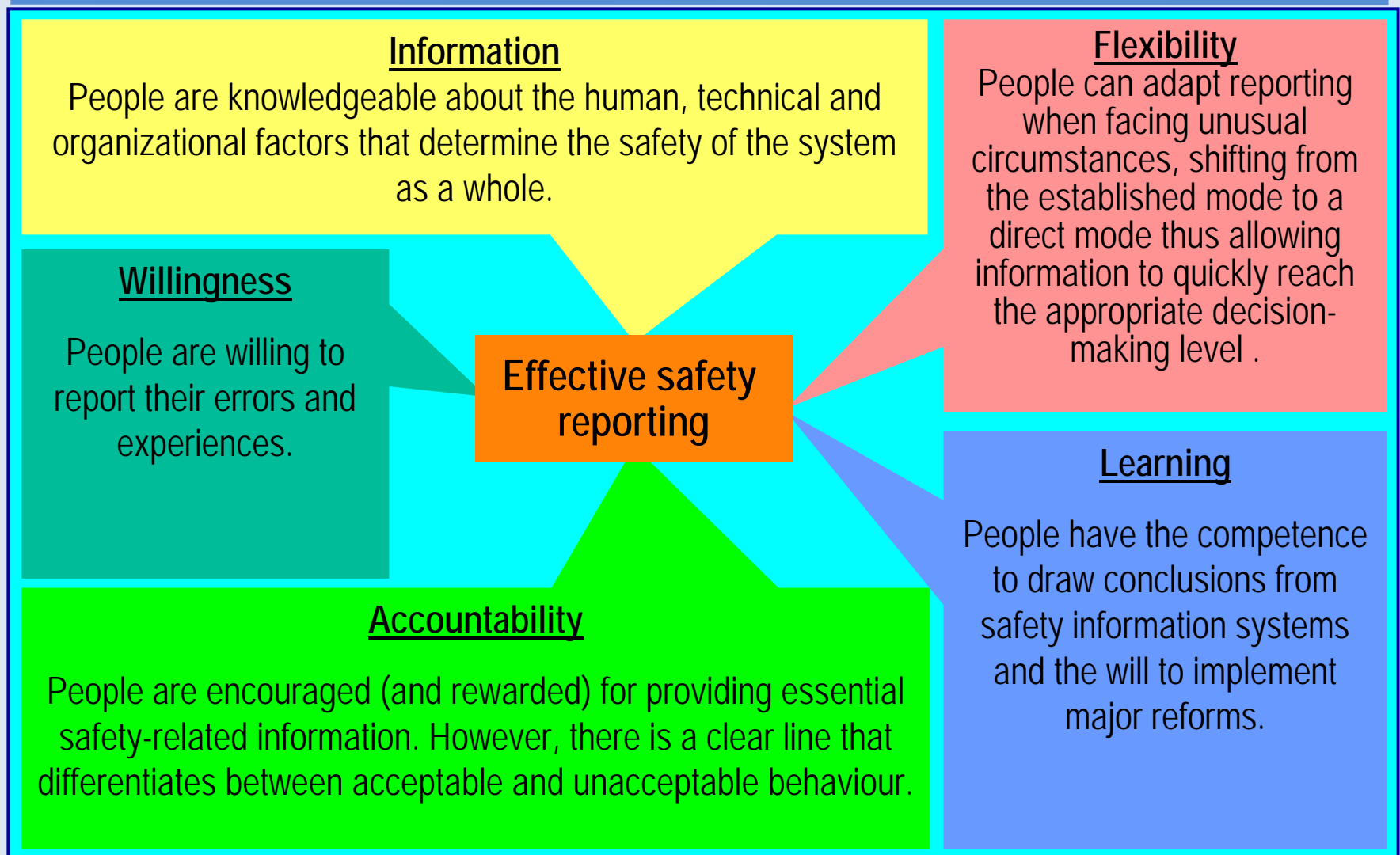
❖ Sets the boundaries for **acceptable behaviour in the workplace** by establishing norms and limits.

❖ Provides a frame work for managerial and employee decision-making

➢ *"This is how we do things here, and how we talk about the way we do things here".*

❖ Organizational/corporate culture shapes – among many others – **safety reporting procedures and practices** by operational personnel.

Safety culture

❖ A trendy notion with potential for misperceptions and misunderstandings

➢ A construct, an abstraction

➢ It is the consequence of a series of organizational processes (i.e., an outcome)

❖ Safety culture is not **an end in itself**, but **a means** to achieve an essential safety management prerequisite:

➢ **Effective safety reporting**

Effective safety reporting – Five basic traits

Information

People are knowledgeable about the human, technical and organizational factors that determine the safety of the system as a whole.

Flexibility

People can adapt reporting when facing unusual circumstances, shifting from the established mode to a direct mode thus allowing information to quickly reach the appropriate decision-making level .

Willingness

People are willing to report their errors and experiences.

Effective safety reporting

Learning

People have the competence to draw conclusions from safety information systems and the will to implement major reforms.

Accountability

People are encouraged (and rewarded) for providing essential safety-related information. However, there is a clear line that differentiates between acceptable and unacceptable behaviour.

Three options

❖ **Organizations and the management of information**

➢ **Pathological** – Hide the information

➢ **Bureaucratic** – Restrain the information

➢ **Generative** – Value the information

Three possible organizational cultures

Source: Ron Westrum

	Pathological	Bureaucratic	Generative
Information	Hidden	Ignored	Sought
Messengers	Shouted	Tolerated	Trained
Responsibilities	Shirked	Boxed	Shared
Reports	Discouraged	Allowed	Rewarded
Failures	Covered up	Merciful	Scrutinized
New ideas	Crushed	Problematic	Welcomed
Resulting organization	Conflicted organization	"Red tape" organization	Reliable organization

Safety investigation

❖ **For "funereal" purposes**

  ➢ To put losses behind

  ➢ To reassert trust and faith in the system

  ➢ To resume normal activities

  ➢ To fulfil political purposes

❖ **For improved system reliability**

  ➢ To learn about system vulnerability

  ➢ To develop strategies for change

  ➢ To prioritize investment of resources

Investigation ⊗

❖ The facts

- ➤ An old generation four engine turboprop freighter flies into severe icing conditions.

- ➤ Engines 2 and 3 flameout as consequence of ice accretion, and seven minutes later engine 4 fails.

- ➤ The flight crew manages to re-start engine number 2.

- ➤ Electrical load shedding is not possible, and the electrical system reverts to battery power.

- ➤ ...

Investigation ❌

❖ ... The facts

➤ While attempting to conduct an emergency landing, all electrical power is lost.

➤ All that is left to the flight crew is the self-powered standby gyro, a flashlight and the self-powered engine instruments.

➤ The flight crew is unable to maintain controlled flight, and the aircraft crashes out of control.

Investigation ⊗

❖ **Findings**

➤ Crew did not use the weather radar.

➤ Crew did not consult the emergency check-list.

➤ Demanding situation requiring decisive thinking and clear action.

➤ Conditions exceeded certification condition for the engines.

➤ Did not request diversion to a closer aerodrome.

➤ ...

Investigation ❌

❖ ... Findings

➤ Crew did not use correct phraseology to declare emergency.

➤ Poor crew resource management (CRM).

➤ Mismanagement of aircraft systems.

➤ Emergency checklist – presentation and visual information.

➤ Flight operations internal quality assurance procedures.

Investigation ⊗

❖ Causes

> ➤ Multiple engine failures

> ➤ Incomplete performance of emergency drills

> ➤ Crew actions in securing and re-starting engines

> ➤ Drag from unfeathered propellers

> ➤ Weight of ice

> ➤ Poor CRM

> ➤ Lack of contingency plans

> ➤ Loss of situational awareness

Investigation ⊗

❖ **Safety recommendations**

➢ Authority should remind pilots to use correct phraseology.

➢ Authority should research into most effective form of presentation of emergency reference material.

Investigation Y

❖ **The facts**

➢ An old generation two engine turboprop commuter aircraft engaged in a regular passenger transport operation is conducting a non-precision approach in marginal weather conditions in an uncontrolled, non-radar, remote airfield.

➢ The flight crew conducts a straight-in approach, not following the published approach procedure.

➢ …

Investigation Y

❖ ... The facts

➢ Upon reaching MDA, the flight crew does not acquire visual references.

➢ The flight crew abandons MDA without having acquired visual references to pursue the landing.

➢ The aircraft crashes into terrain short of the runway.

Investigation

❖ **Findings**

➢ The crew made numerous mistakes.

But

➢ Crew composition legal but unfavourable in view of demanding flight conditions.

➢ According to company practice, pilot made a direct approach, which was against regulations.

➢ …

Investigation

❖ … But

➢ The company had consistently misinterpreted regulations.

➢ Level of safety was not commensurate with the requirements of a scheduled passenger operation.

➢ Aerodrome operator had neither the staff nor the resources to ensure regularity of operations.

➢ …

Investigation

❖ ... But

➢ Lack of standards for commuter operations.

➢ Lack of supervision of air traffic facilities.

➢ Authorities' disregard of previous safety violations.

➢ Legislation out of date.

➢ ...

Investigation

❖ ... But

➢ Conflicting goals within the authority.

➢ Lack of resources within the authority.

➢ Lack of aviation policy to support the authority.

➢ Deficiencies in the training system.

Investigation

❖ Causes

➤ Decision to continue approach below MDA without visual contact.

➤ Performance pressures.

➤ Airline's poor safety culture.

Investigation

❖ **Safety recommendations**
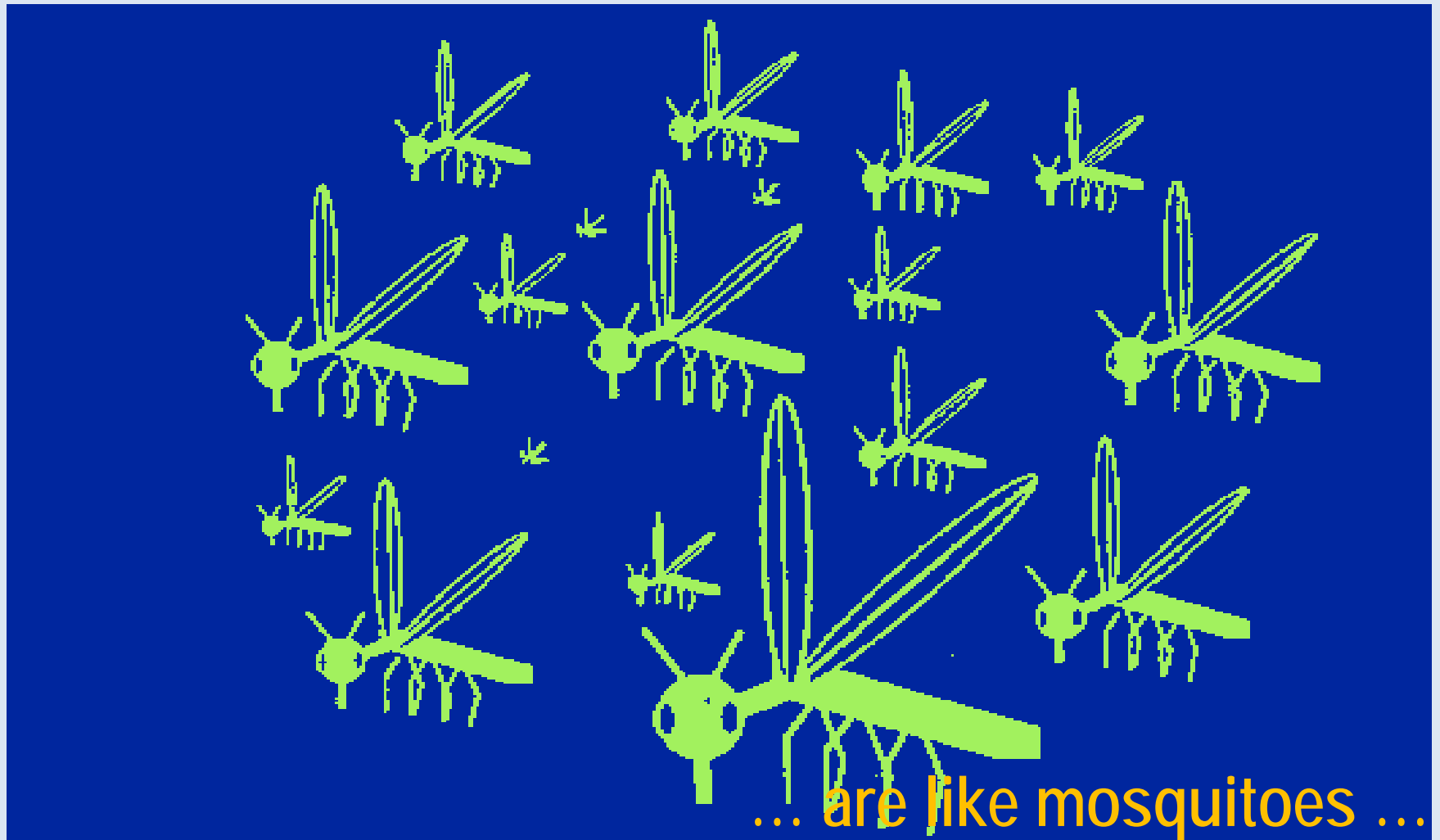
➢ "Tip-of-the-arrow" recommendations.

But

➢ Review the process of granting AOC.

➢ Review the training system.

➢ Define an aviation policy which provides support to the task of the aviation administration.
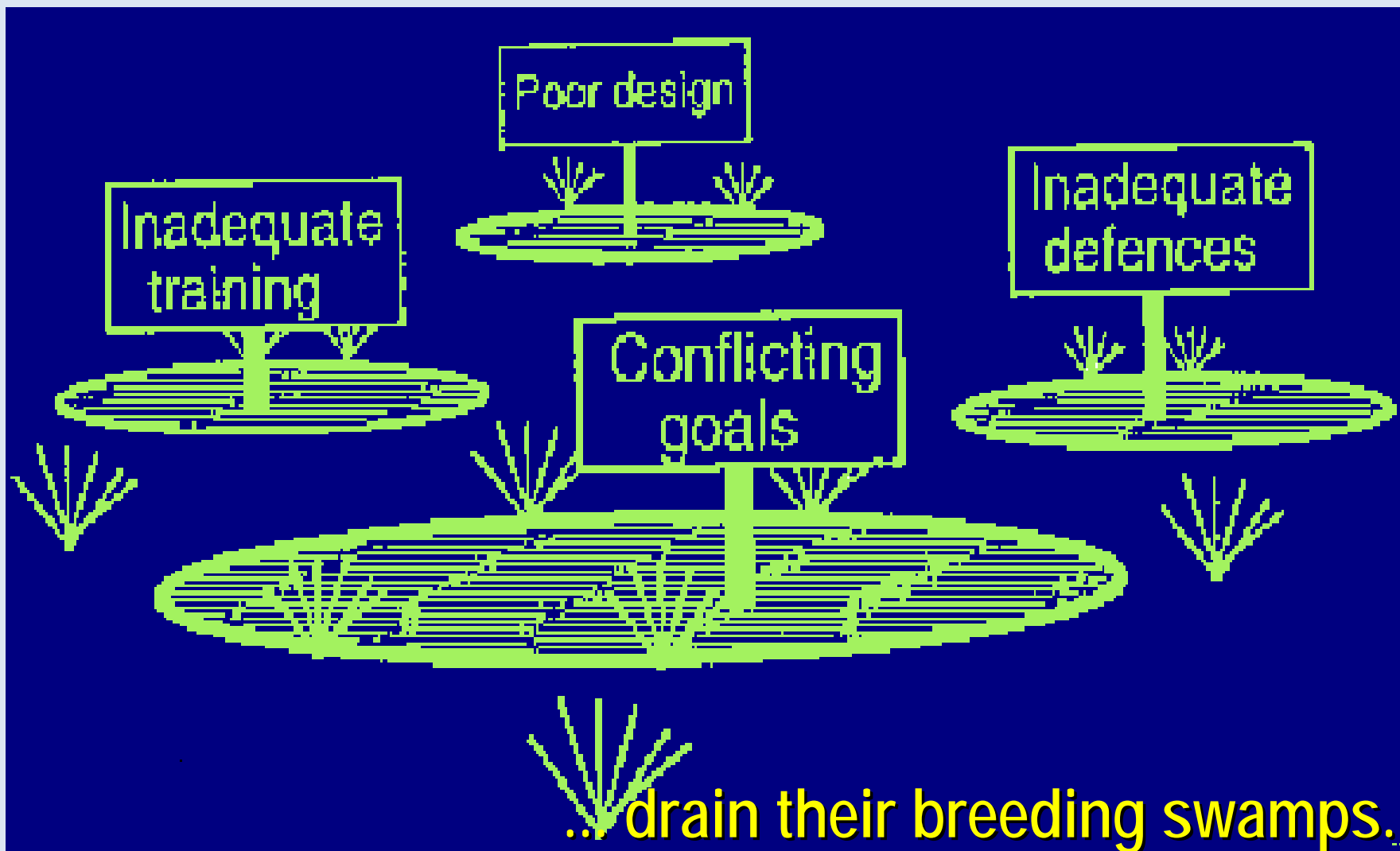
➢ …

Investigation

❖ ... But

➤ Reform aviation legislation.

➤ Reinforce existing legislation as interim measure.

➤ Improve both accident investigation and aircraft and airways inspection processes.

Errors ...

... are like mosquitoes ...

To fight them …

Poor design

Inadequate training

Conflicting goals

Inadequate defences

... drain their breeding swamps.

Basic safety concepts

Questions and answers

Questions and answers

❖ **Q**: How is safety defined in document 9859?

❖ **A**:

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

Slide number: 7

Questions and answers

❖ Q: Enumerate the five building blocks of the organizational accident.

❖ A:

Organizational processes

Workplace conditions

Latent conditions

Active failures

Defences
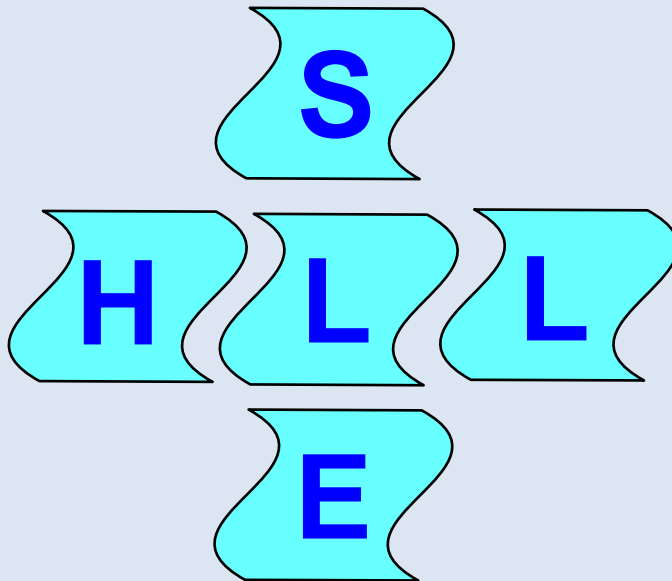
Slide number: 16

Questions and answers
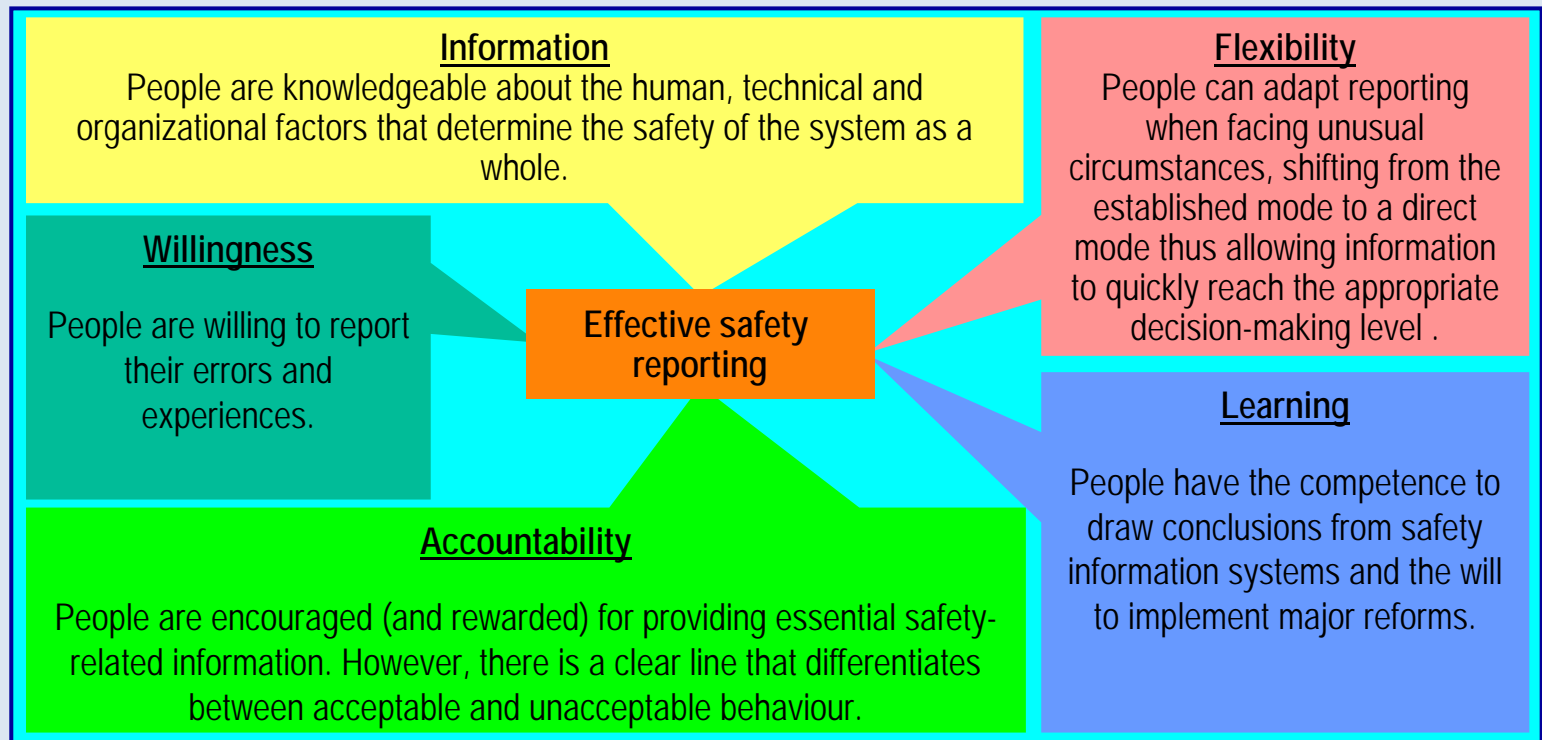
❖ Q: Explain the components of the SHEL(L) Model.

❖ A:

❖ Software

❖ Hardware

❖ Environment

❖ Liveware

❖ Liveware, other persons

Slide number: 20

Questions and answers

❖ Q: Enumerate three basic traits underlying effective safety reporting.

❖ A:

Information
People are knowledgeable about the human, technical and organizational factors that determine the safety of the system as a whole.

Flexibility
People can adapt reporting when facing unusual circumstances, shifting from the established mode to a direct mode thus allowing information to quickly reach the appropriate decision-making level .

Willingness
People are willing to report their errors and experiences.

Effective safety reporting

Learning
People have the competence to draw conclusions from safety information systems and the will to implement major reforms.

Accountability
People are encouraged (and rewarded) for providing essential safety-related information. However, there is a clear line that differentiates between acceptable and unacceptable behaviour.

Slide number: 35

Questions and answers

❖ **Q**: How can organizations be characterized, depending upon their management of safety information?

❖ **A**:

➢ **Pathological** – Hide the information

➢ **Bureaucratic** – Restrain the information

➢ **Generative** – Value the information

Slide number: 36

Points to remember

1. *The organizational accident.*

2. *Operational contexts and human performance*

3. *Errors and violations.*

4. *Organizational culture and effective safety reporting.*

5. *The management of safety information.*

Basic safety concepts

Exercise 02/01 – The Anytown City Airport accident *(Handout Nº 1)*

The Anytown City Airport accident

❖ In the late hours of a summer Friday evening, while landing on a runway heavily contaminated with water, a twin-engine jet transport aircraft with four crew members and 65 passengers on board overran the westerly end of the runway at Anytown City airport.

❖ The aircraft came to rest in the mud a short distance beyond the end of the runway.

❖ There were no injuries to crew or passengers, and there was no apparent damage to the aircraft as a consequence of the overrun. However, a fire started and subsequently destroyed the aircraft.

The Anytown City Airport accident

❖ **Group activity:**

➢ A facilitator will be appointed, who will coordinate the discussion.

➢ A summary of the discussion will be written on flip charts, and a member of the group will brief on their findings in a plenary session.

❖ **Required task:**

➢ Read the text related to the accident of the twin-engined jet transport at Anytown City Airport.

➢ …

The Anytown City Airport accident

❖ … required task:

➢ From the investigation report of the above accident, you should identify:

1. **Organizational processes** that influenced the operation and which felt under the responsibility of senior management (i.e. those accountable for the allocation of resources);

2. **Latent conditions** in the system safety which became precursors of active failures;

3. **Defences** which failed to perform due to weaknesses, inadequacies or plain absence; …

The Anytown City Airport accident

❖ ... required task:

4. **Workplace conditions**, which may have influenced operational personnel actions; and

5. **Active failures**, including errors and violations

❖ When you have concluded the above, your task is to complete the Table 02/01 – Analysis *(Handout N° 1)* classifying your findings in accordance with the organizational accident model.

The organizational accident

Safety Management Systems (SMS) Course

Module N° 2 – Basic safety concepts