

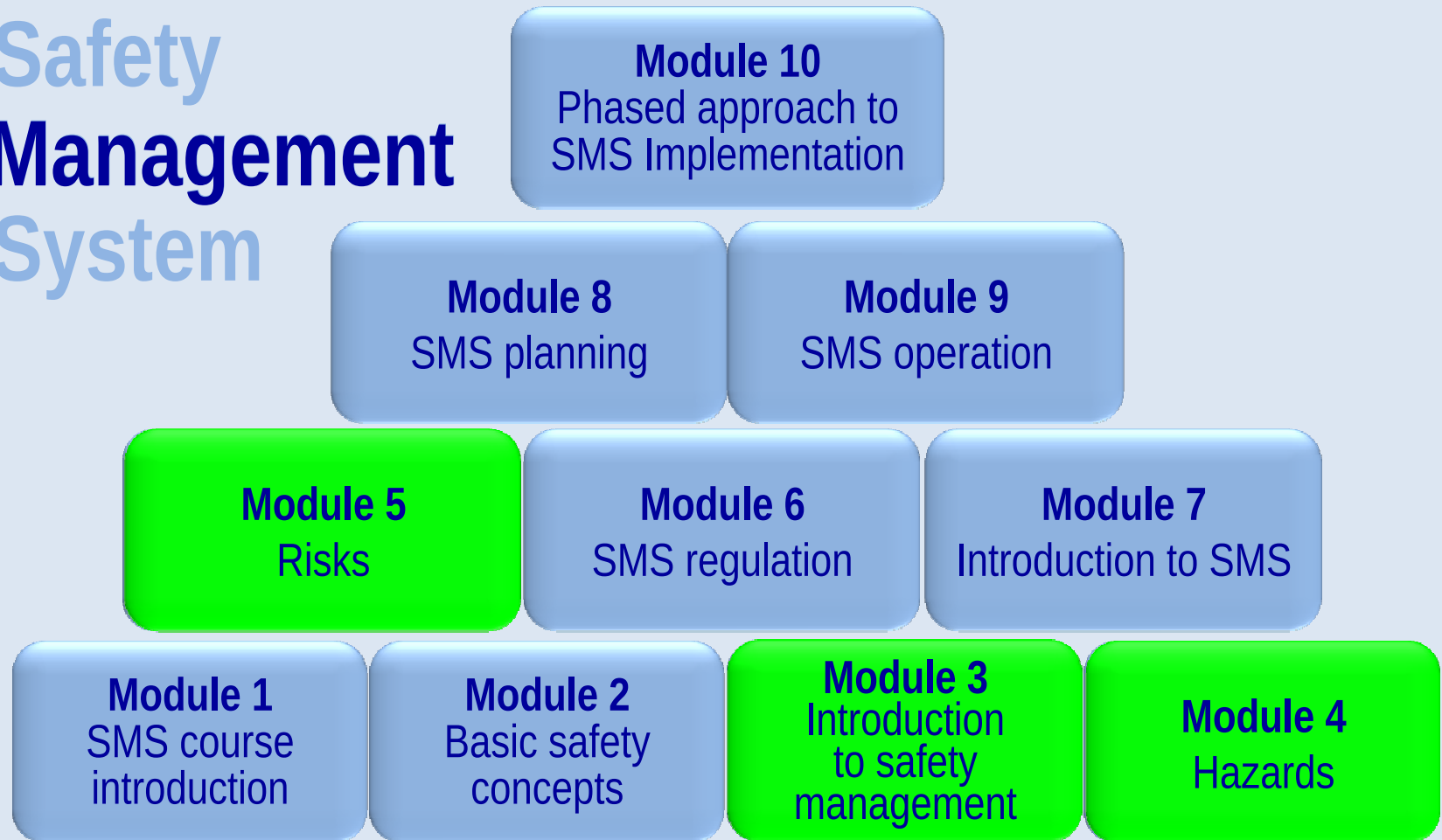
Safety Management Systems (SMS) Course



Module N° 5 – Risks

Building an SMS

Safety Management System



Objective

❖ *At the end of this module, participants will be able to apply the fundamentals of risk management through a case study.*

Outline

- ❖ Definition of risk
- ❖ First fundamental – Risk management
- ❖ Second fundamental – Risk probability
- ❖ Third fundamental – Risk severity
- ❖ Fourth fundamental - Risk assessment and tolerability
- ❖ Fifth fundamental – Risk control/mitigation
- ❖ Risk management warm-up exercises
- ❖ Questions and answers
- ❖ Points to remember
- ❖ Exercise 05/01 – *Accident of a Boeing B-747 at an International Airport (See Handout N° 4)*

Definition of risk

- ❖ **Risk** – The assessment, expressed in terms of predicted **probability** and **severity**, of the consequence(s) of a hazard taking as reference the worst foreseeable situation.
- *A wind of 15 knots blowing directly across the runway is a **hazard**.*
 - *The potential that a pilot may not be able to control the aircraft during takeoff or landing is one of the **consequences** of the hazard.*
 - *The assessment of the consequences of the potential loss of control of the aircraft by the pilot expressed in terms of probability and severity is the **risk**.*

First fundamental – Risk management

❖ What is it?

- The **identification**, **analysis** and **elimination**, and/or **mitigation** to an acceptable level of risks that threaten the capabilities of an organization.

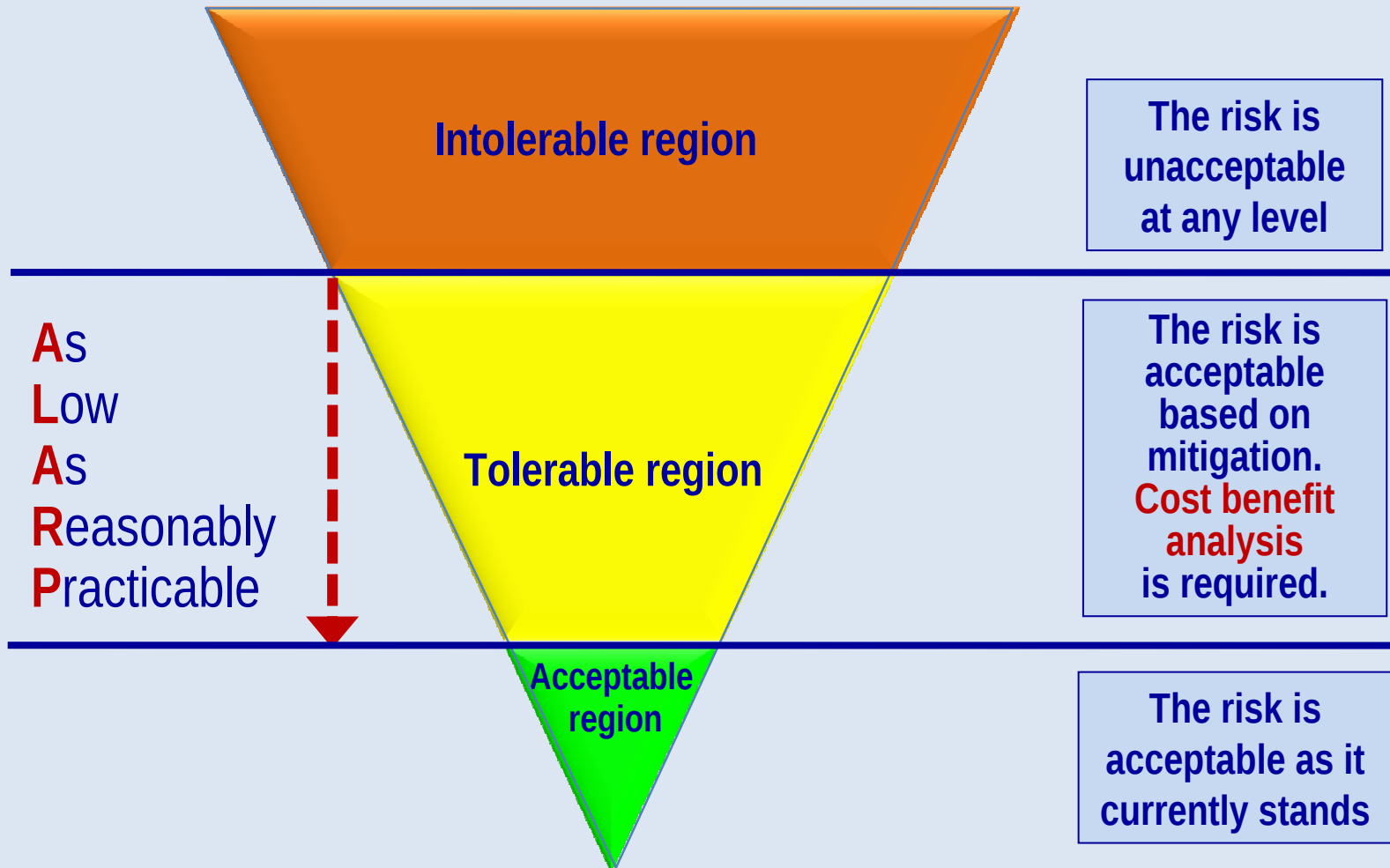
❖ What is the objective?

- Aims at a balanced allocation of resources to address **all** risks and viable **risk** control and mitigation.

❖ Why is it important?

- A key component of safety management systems.
- Data-driven approach to safety resources allocation, thus defensible and easier to explain.

Risk management



Cost-benefit analysis

❖ Direct costs

- The obvious costs, which are easily determined. The high costs of exposure of hazards can be reduced by insurance coverage.
 - Purchasing insurance only transfers monetary risk,
does not address the safety hazard

❖ Indirect costs

- The uninsured costs. An understanding of uninsured costs (or indirect costs) is fundamental to understand the economics of safety.

Cost-benefit analysis

❖ Indirect costs may amount to more than the direct costs resulting from exposure to hazards:

- Loss of business
- Damage to the reputation
- Loss of use of equipment
- Loss of staff productivity
- Legal actions and claims
- Fines and citations
- Insurance deductibles



Second fundamental - Risk probability

❖ Definition(s)

➤ **Probability** – The likelihood that an unsafe event or condition might occur.

Second fundamental - Risk probability

❖ **Questions** for assessing the probability of an occurrence:

- Is there a history of occurrences like the one being assessed, or is the occurrence an isolated event?
- What other equipment, or similar type components, might have similar defects?

Second fundamental - Risk probability

❖ ... questions such as:

- What number of operating or maintenance personnel must follow the procedure (s) in question?
- How frequently is the equipment or procedure under assessment used?

Second fundamental - Risk probability

Probability of occurrence		
Qualitative definition	Meaning	Value
Frequent	Likely to occur many times (<i>has occurred frequently</i>)	5
Occasional	Likely to occur some times (<i>has occurred infrequently</i>)	4
Remote	Unlikely, but possible to occur (<i>has occurred rarely</i>)	3
Improbable	Very unlikely to occur (<i>not known to have occurred</i>)	2
Extremely improbable	Almost inconceivable that the event will occur	1

Third fundamental – Risk severity

❖ Definition(s)

➤ **Severity** – The possible consequences of an unsafe event or condition, taking as reference the **worst foreseeable situation.**

Third fundamental – Risk severity

❖ Define the severity in terms of consequences for:

- Property
- Finance
- Liability
- People
- Environment
- Image
- Public confidence

Third fundamental – Risk severity

❖ **Questions** for assessing the severity of an occurrence:

➤ How many **lives may be lost?**

- Employees
- Passengers
- Bystanders
- General public

➤ What is the **environmental impact?**

- Spill of fuel or other hazardous product
- Physical disruption of natural habitat

Third fundamental – Risk severity

❖ ... questions such as:

- What is the severity of the **property or financial damage**?
 - Direct operator property loss
 - Damage to aviation infrastructure
 - Third party damage
 - Financial impact and economic impact for the State
- Are there **organizational, management or regulatory implications** that might generate larger threats to public safety?
- What are the likely **political implications** and/or **media interest**?

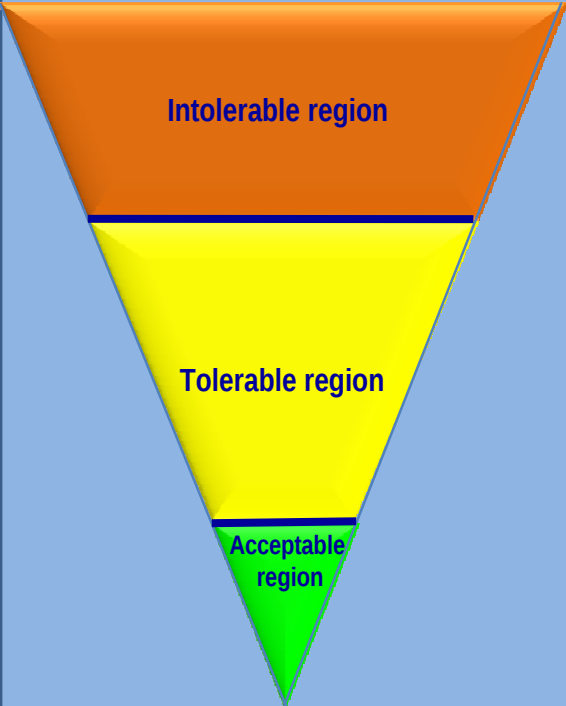
Third fundamental – Risk severity

Severity of occurrences		
Aviation definition	Meaning	Value
Catastrophic	➤ Equipment destroyed. ➤ Multiple deaths.	A
Hazardous	➤ A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. ➤ Serious injury. ➤ Major equipment damage.	B
Major	➤ A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency. ➤ Serious incident. ➤ Injury to persons.	C
Minor	➤ Nuisance. ➤ Operating limitations. ➤ Use of emergency procedures. ➤ Minor incident.	D
Negligible	➤ Little consequences	E

Fourth fundamental – Risk assessment

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

Fourth fundamental – Risk tolerability

Risk management	Assessment 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	Acceptable based on risk mitigation. It might require management decision
Acceptable region	3E, 2D, 2E, 1A, 1B, 1C, 1D, 1E	Acceptable

Fifth fundamental – Risk control/mitigation

❖ Definition(s)

- **Mitigation** – Measures to address the potential hazard or to reduce the risk probability or severity.
- Risk mitigation = Risk control

(Mitigate – To make milder, less severe or less harsh)

Fifth fundamental – Risk control/mitigation

❖ Strategies

- **Avoidance** – The operation or activity is cancelled because risks exceed the benefits of continuing the operation or activity.
 - *Operations into an aerodrome surrounded by complex geography and without the necessary aids are cancelled.*

Fifth fundamental – Risk control/mitigation

❖ Strategies

➤ **Reduction** – The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the accepted risks.

- *Operations into an aerodrome surrounded by complex geography and without the necessary aids are limited to day-time, visual conditions.*

Fifth fundamental – Risk control/mitigation

❖ Strategies

- **Segregation of exposure** – Action is taken to isolate the effects of the consequences of the hazard or build-in redundancy to protect against it.
 - *Operations into an aerodrome surrounded by complex geography are limited to aircraft with specific/performance navigation capabilities.*
 - *Non RVSM equipped aircraft not allowed to operate into RVSM airspace.*

Safety risk management at a glance



Risk mitigation – Defences

❖ Recalling the three basic defences in aviation:

➤ Technology

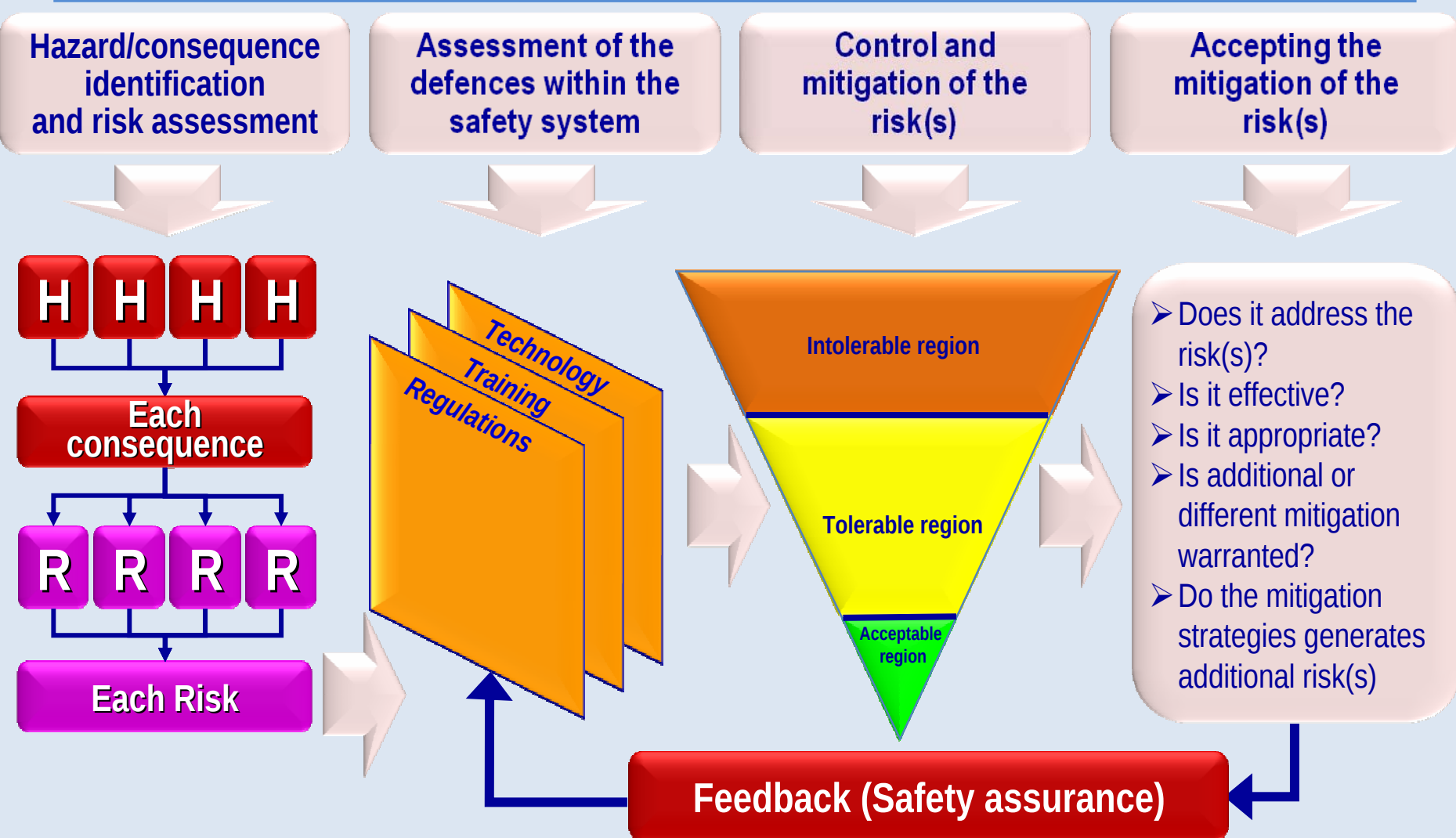
➤ Training

➤ Regulations

Risk mitigation – Defences

- ❖ As part of the risk mitigation, determine:
 - Do defences to protect against such risk (s) exist?
 - Do defences function as intended?
 - Are the defences practical for use under actual working conditions?
 - Is staff involved aware of the risks and the defences in place?
 - Are additional risk mitigation measures required?

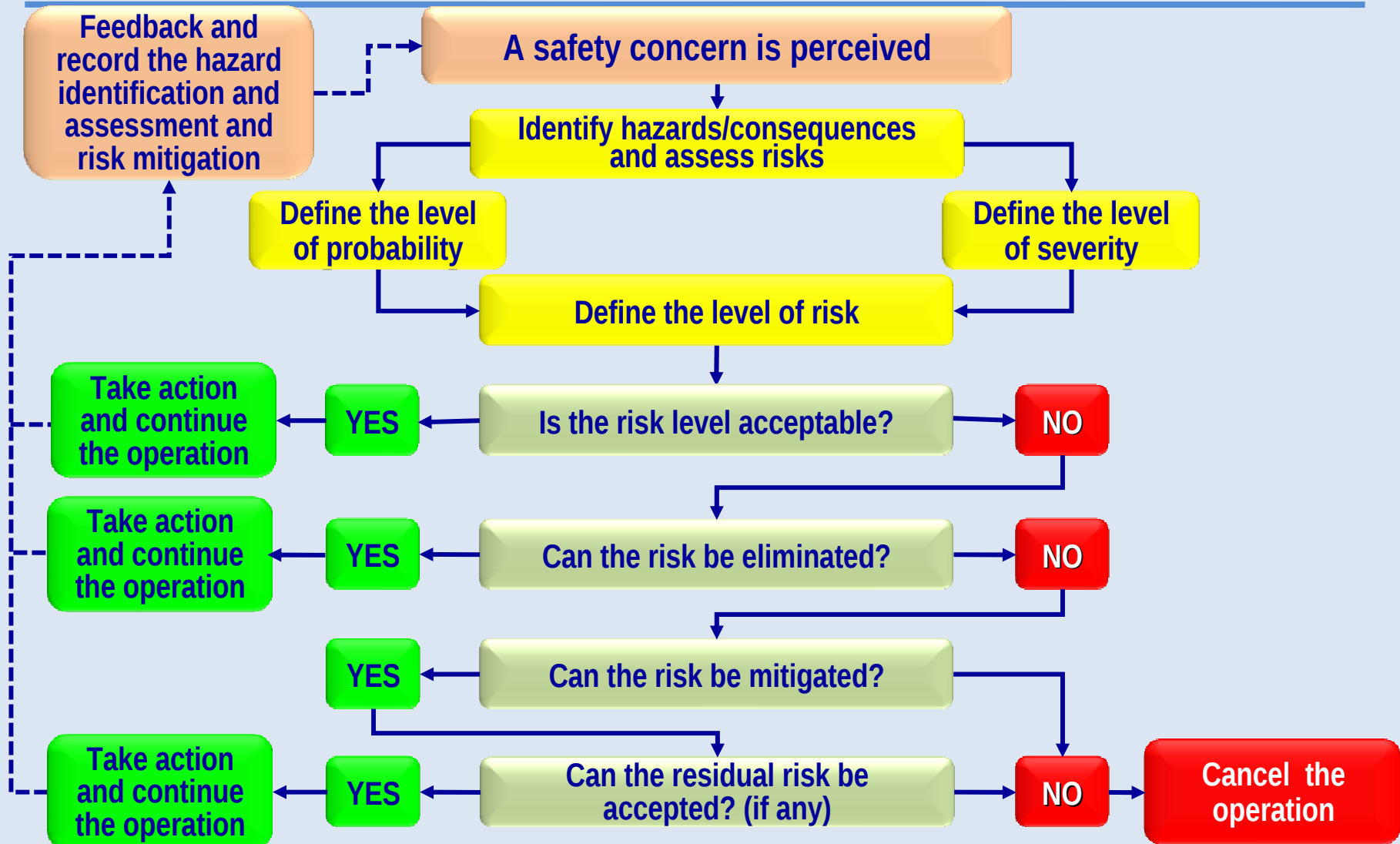
Risk mitigation at a glance



As a reminder

- ❖ There is no such thing as absolute safety – In aviation it is not possible to eliminate all risks.
- ❖ Risks can be managed to a level **“as low as reasonably practicable” (ALARP)**
- ❖ Risk mitigation must be balanced against:
 - time
 - cost
 - difficulty of taking measures to reduce or eliminate the risk (i.e. managed).
- ❖ Effective risk management seeks to **maximize the benefits of accepting a risk** (a reduction in time and cost) while **minimizing the risk itself**.
- ❖ Communicate the rationale for risk decisions to gain acceptance by stakeholders affected by them.

Risk management process at a glance





Risks

Risk management warm-up exercises

Warm-up exercise N° 05/01

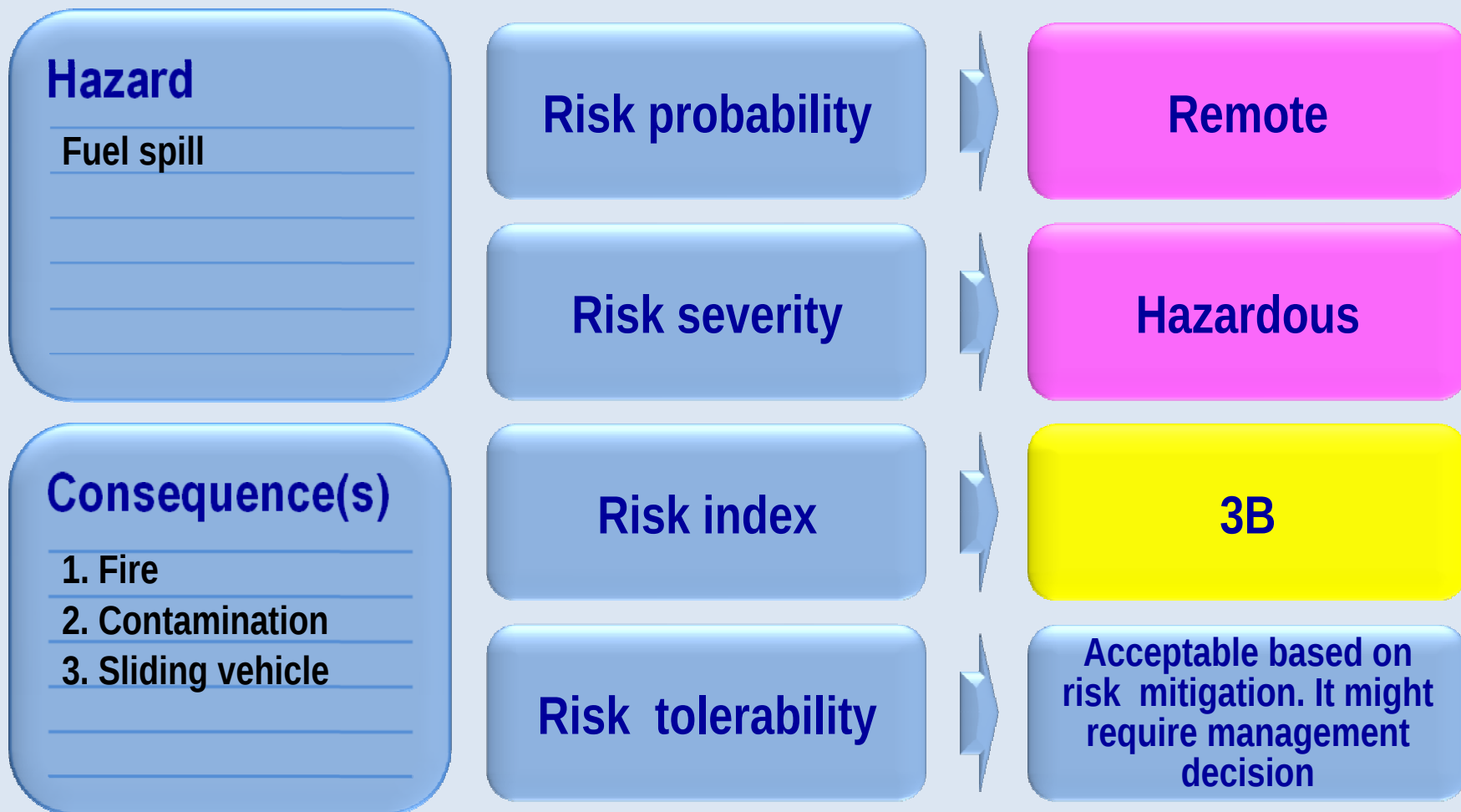
❖ Scenario:

- Fuel spill on the apron area surface of approximately 25 m (75 ft) length and 5 m (15 ft) width, produced by an A310 ready to pushback and taxi for departure.

❖ Report by the apron responsible person:

- After the A310 pushback the spill was contained and the apron area was decontaminated.

Warm-up exercise N°05/01 – results



Warm-up exercise N°05/02

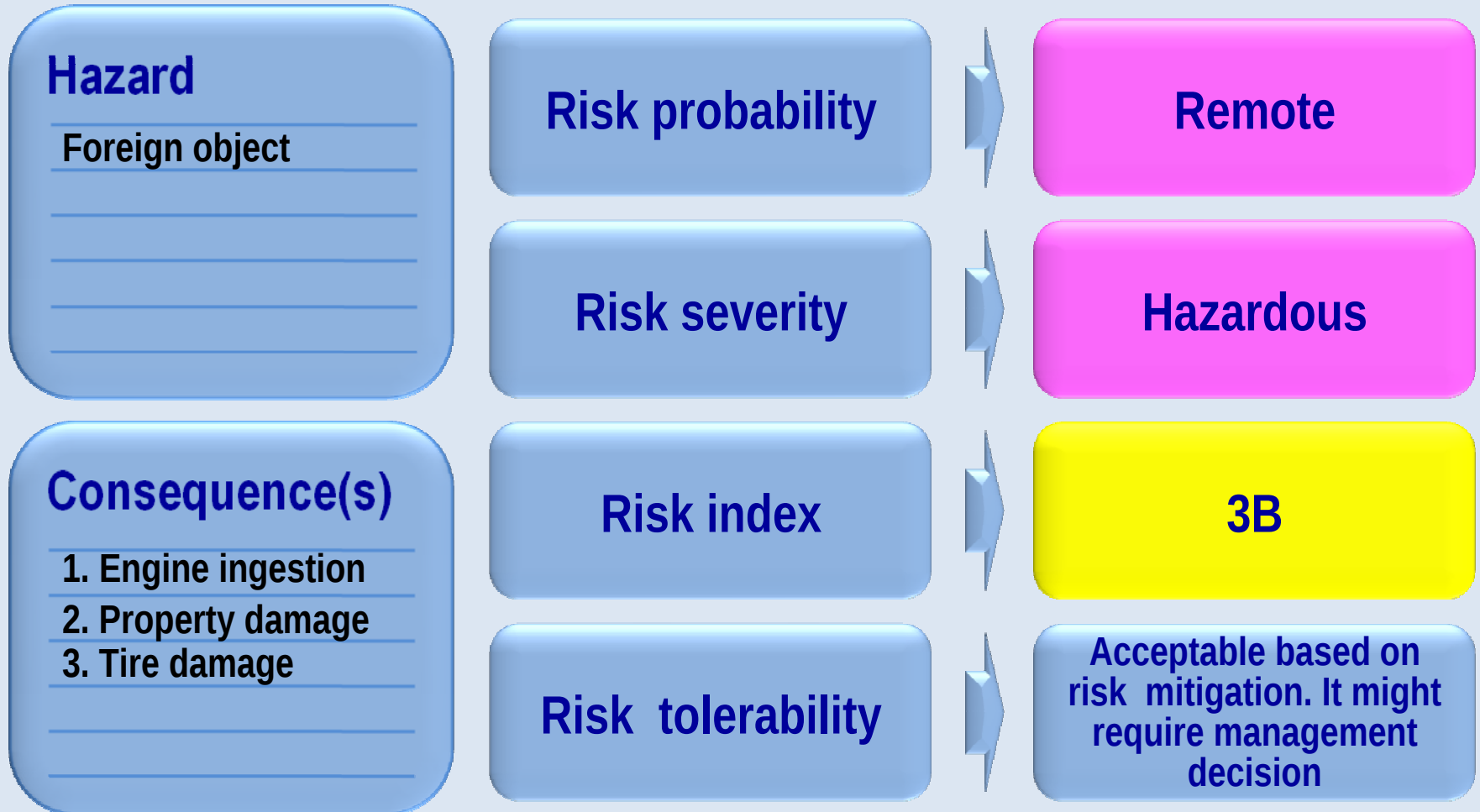
❖ Scenario:

- It was observed that airline baggage handling personnel generates FO(D) on the aerodrome apron area .

❖ Report by the apron responsible person:

- It should be noted that airline baggage handling personnel are not complying with safety standards as set in the aerodrome operating manual. This is considered a hazard that can produce incident or accident in the movement area.

Warm-up exercise N°05/02– results



Warm-up exercise N° 05/03

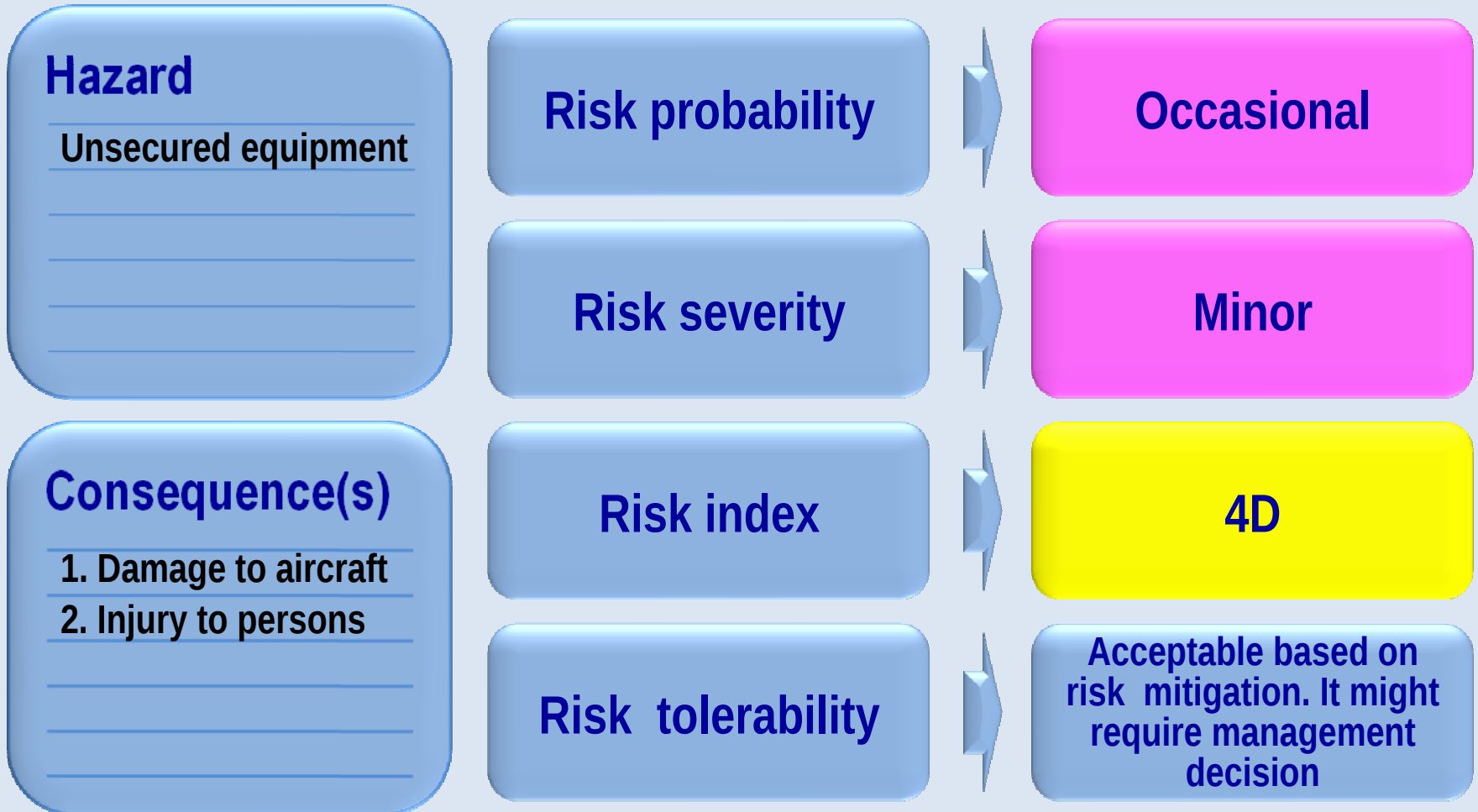
❖ Scenario:

- A parked aircraft shows damage in the left wing root near the fuselage. Such damage was caused by a maintenance stair hitting the aircraft as a consequence of the wind, apparently because the stair was not properly restrained.

❖ Report by the apron responsible person:

- In conditions of strong winds it is essential that all equipment around aircraft is properly restrained and locked, thus preventing the possibility of aircraft damage.

Warm-up exercise N° 05/03 – results



Warm-up exercise N° 05/04

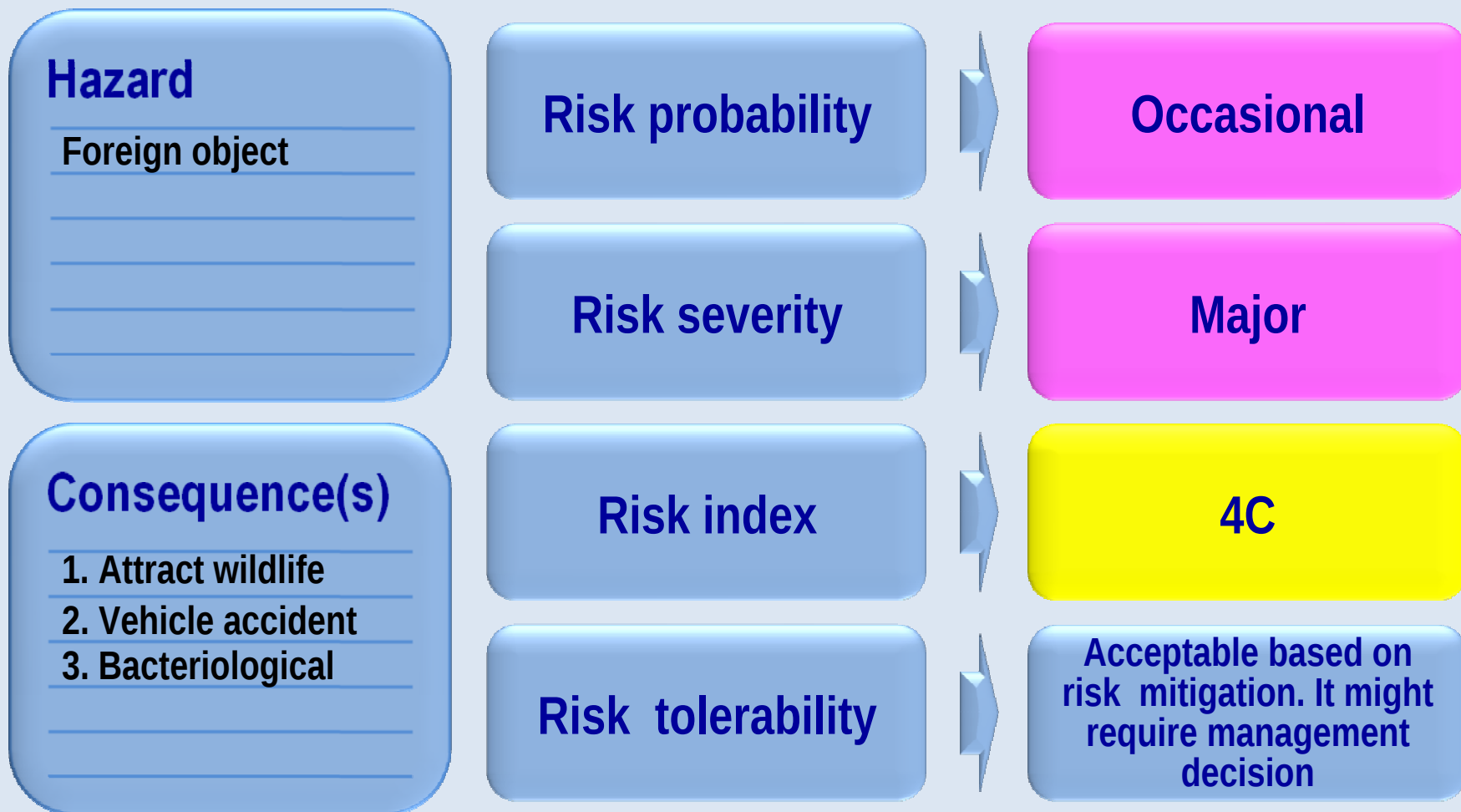
❖ Scenario:

- The vehicle and ramp equipment parking area behind the fingers shows a large amount of FO(D) (food, trays, plastics, pillows, etc.) left behind by an airline.

❖ Report by the apron responsible person:

- The presence of decomposed food and others dangerous material was informed to the airline, since in addition to FO(D), this presents a bacteriological danger for people who operate in this sector, also attracting animals to the operative apron.

Warm-up exercise N° 05/04 – results



Warm-up exercise N° 05/05

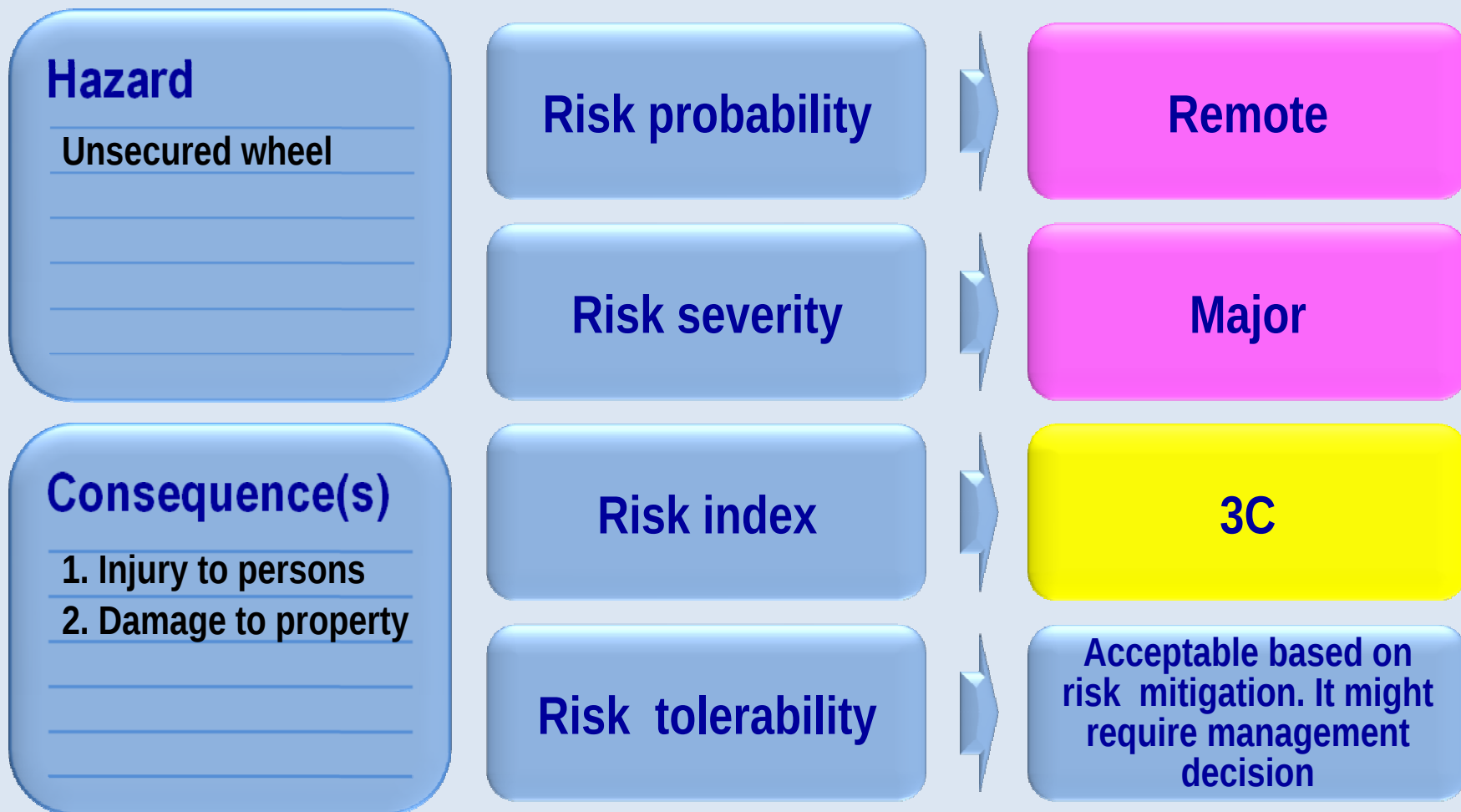
❖ Scenario:

- A loose wheel, apparently from a baggage cart, was observed in the handling area. The driver apparently did not notice what happened. The wheel rolled at high speed through the area, hitting the fence accessing the fuel zone.

❖ Report by the apron responsible person:

- This could have caused injuries to ramp personnel in addition to material damage to equipment and/or aerodrome facilities. We have insisted in the past on the periodic verification of all equipment and vehicles that operate in the aerodrome apron area.

Warm-up exercise N° 05/05 – results



Warm-up exercise N° 05/06

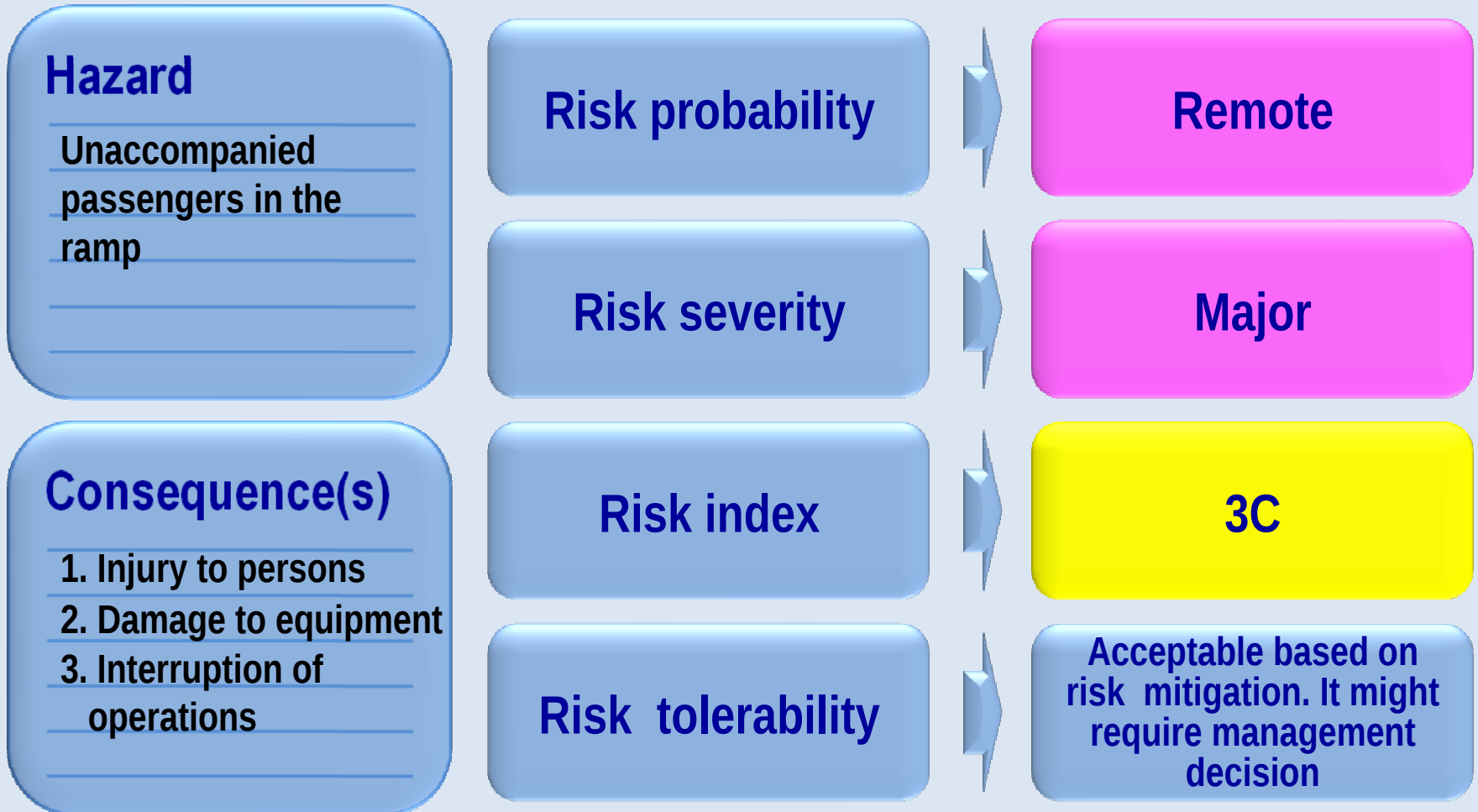
❖ Scenario:

- The absence of airline personnel attending the stairs was observed in three occasions, in flights from different companies. The presence of airline personnel is necessary to guide passengers when embarking and disembarking.

❖ Report by the apron responsible person:

- This is a risk for passengers, since they should access the apron to board aircraft in an orderly manner under the guidance of airline personnel.

Warm-up exercise N° 05/06 – results





Risks

Questions and answers

Questions and answers

❖ **Q:** Define risk management.

❖ **A:**

➤ The identification, analysis and elimination, and/or mitigation of risks that threaten the capabilities of an organization to an acceptable level.

Slide number: 6

Questions and answers

❖ **Q:** What are the five designations for risk probability?

❖ **A:**

Frequent

Occasional

Remote

Improbable

**Extremely
improbable**

Slide number: 13

Questions and answers

❖ **Q:** What are the five designations for risk severity?

❖ **A:**

Catastrophic

Hazardous

Major

Minor

Negligible

Slide number: 18

Questions and answers

❖ **Q:** Describe the three basic risk mitigation strategies.

❖ **A:**

➤ **Avoidance** – The operation or activity is cancelled because risks exceed the benefits of continuing the operation or activity.

➤ **Reduction** – The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the accepted risks.

➤ **Segregation of exposure** – Action is taken to isolate the effects of the consequences of the hazard or build-in redundancy to protect against it.

Slide number: 22, 23 and 24

Hazards and risks – Closing the loop

- ❖ **Hazard** – Condition, object or activity **with the potential** of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.
- ❖ **Consequence** – Potential outcome(s) of the hazard.
- ❖ **Risk** – The assessment, expressed in terms of predicted **probability** and **severity**, of the consequence(s) of a hazard taking as reference the worst foreseeable situation.
 - *A wind of 15 knots blowing directly across the runway is a **hazard**.*
 - *The potential that a pilot may not be able to control the aircraft during takeoff or landing is one of the **consequences** of the hazard.*
 - *The assessment of the consequences of the potential loss of control of the aircraft by the pilot expressed in terms of probability and severity is the **risk**.*

Points to remember

1. *The risk assessment matrix.*
2. *The risk assessment criteria table.*
3. *Risk mitigation: avoid, reduce, segregate.*



Risks

Exercise 05/01 – Accident Boeing B-747 at Taipei International Airport (Handout N° 4)

Boeing B-747 at Taipei International Airport

❖ 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.

Boeing B-747 at Taipei International Airport

❖ Scenario

- A Boeing 747 service from Singapore to Los Angeles via Taipei, crashed on takeoff from Taipei's CKS International Airport at 23:18 local time.
- The flight had been cleared for take off from runway 05L.
- Runway 05R was closed due to construction work.
- The flight attempted the take off from runway 05R.

Boeing B-747 at Taipei International Airport

❖ ... Scenario

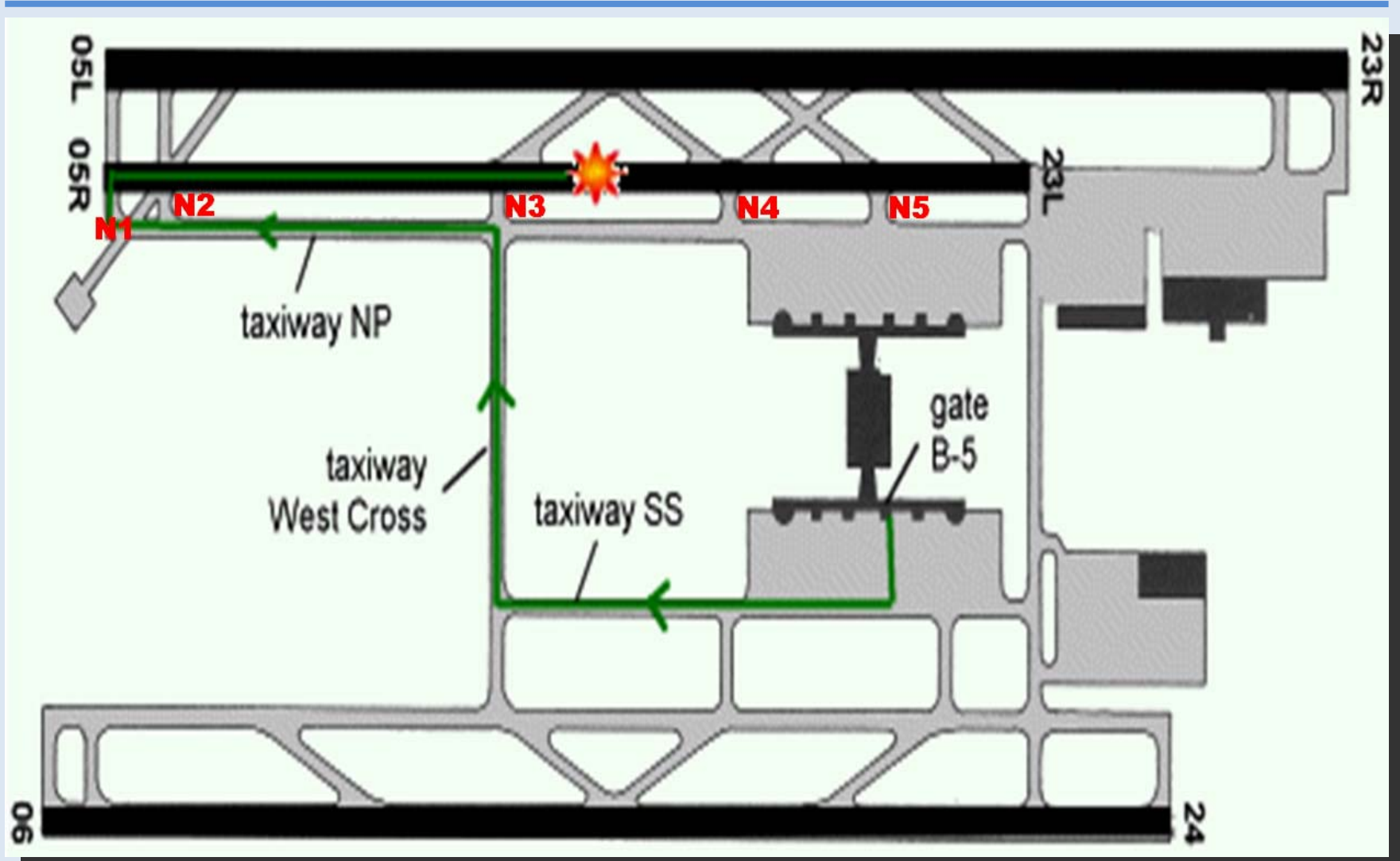
- On takeoff the aircraft hit concrete barriers, excavators and other equipment on the runway 05R.
- The aircraft crashed back onto the runway, breaking up and bursting into flames while sliding down the runway and crashing into other equipment related to work being done on runway 05R.

Boeing B-747 at Taipei International Airport

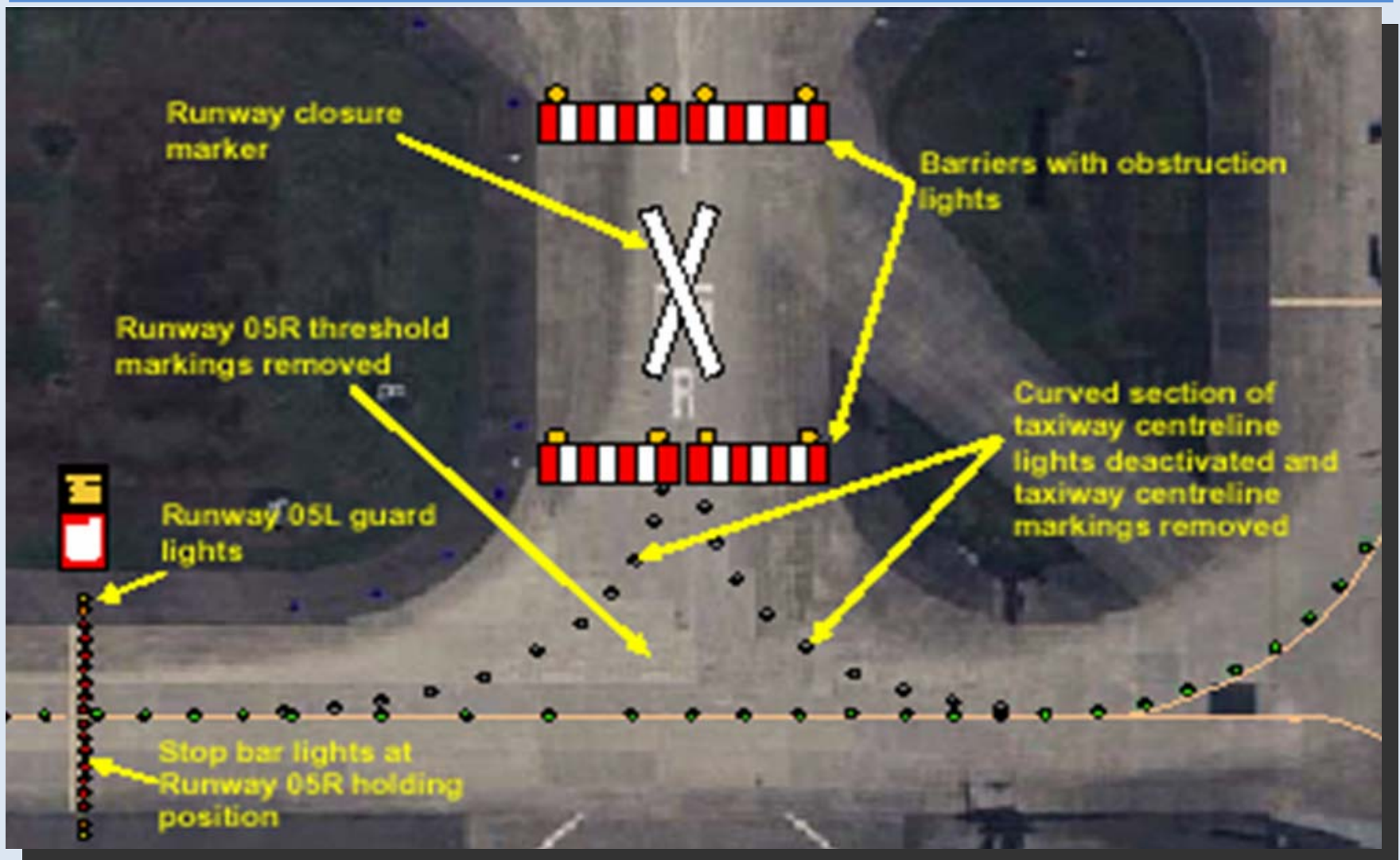
❖ ... Scenario

- Subsequent investigation of the accident confirmed that the flight crew mistakenly attempted takeoff on runway 05R (9029x150ft), instead of the planned runway 05L (12008x200ft).
- Notams indicated that, at the time of the accident, runway 05R was closed for repairs, and that numerous pieces of construction equipment were parked on the runway.

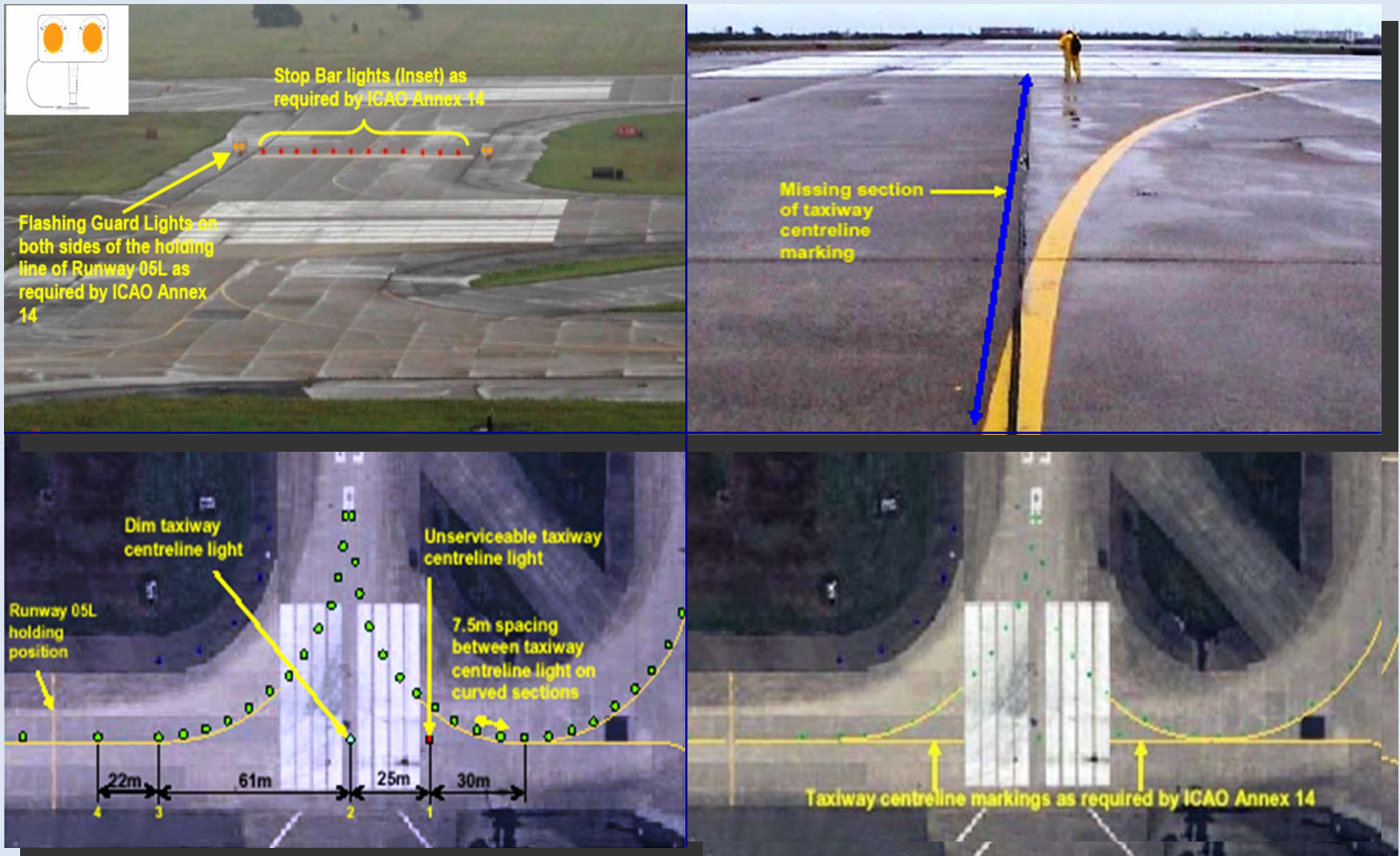
Boeing B-747 at Taipei International Airport



Boeing B-747 at Taipei International Airport



Boeing B-747 at Taipei International Airport



Boeing B-747 at Taipei International Airport



Boeing B-747 at Taipei International Airport

❖ Your task:

- Read the text related to the accident of the Boeing 747 at Taipei International Airport.
- List the type of operation or activity.
- State the generic hazard(s)
- State the specific components of the hazard(s).
- State the hazard-related consequences and assess the risk(s).
- Assess existing defences to control the risk(s) and resulting risk index.
- Propose further action to reduce the risk(s) and resulting risk index.
- Complete the attached log (Table 05/01).

Table 05/01 – Hazard identification and risk management

Nº	Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defences to control risk(s) and risk index	Further action to reduce risk(s) and resulting risk index
1					<i>Risk index:</i> <i>Risk tolerability:</i>	<i>Risk index:</i> <i>Risk tolerability:</i>
2					<i>Risk index:</i> <i>Risk tolerability:</i>	<i>Risk index:</i> <i>Risk tolerability:</i>
3					<i>Risk index:</i> <i>Risk tolerability:</i>	<i>Risk index:</i> <i>Risk tolerability:</i>
4					<i>Risk index:</i> <i>Risk tolerability:</i>	<i>Risk index:</i> <i>Risk tolerability:</i>
5					<i>Risk index:</i> <i>Risk tolerability:</i>	<i>Risk index:</i> <i>Risk tolerability:</i>

Safety Management Systems (SMS) Course



Module N° 5 – Risks