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Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Le « SWISS CHEESE MODEL »

Emmanuel DELBARRE

SWISS CHEESE MODEL

Description

The *Swiss Cheese* model of accident causation, originally proposed by James Reason, compares human system defences to a series of slices of randomly-holed Swiss Cheese arranged vertically and parallel to each other with gaps in-between each slice.
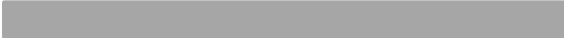
Reason hypothesizes that most accidents can be traced to one or more of four levels of failure:

Organisational influences,
Unsafe supervision,
Preconditions for unsafe acts, and
The unsafe acts themselves.

SWISS CHEESE MODEL

Le modèle du *fromage suisse* pour la causalité des accidents, initialement proposé par James Reason, compare les défenses du système humain à une série de tranches de fromage suisse perforées de manière aléatoire, disposées verticalement et parallèlement, avec des espaces entre chaque tranche. Reason émet l'hypothèse que la plupart des accidents peuvent être attribués à un ou plusieurs des quatre niveaux de défaillance suivants :
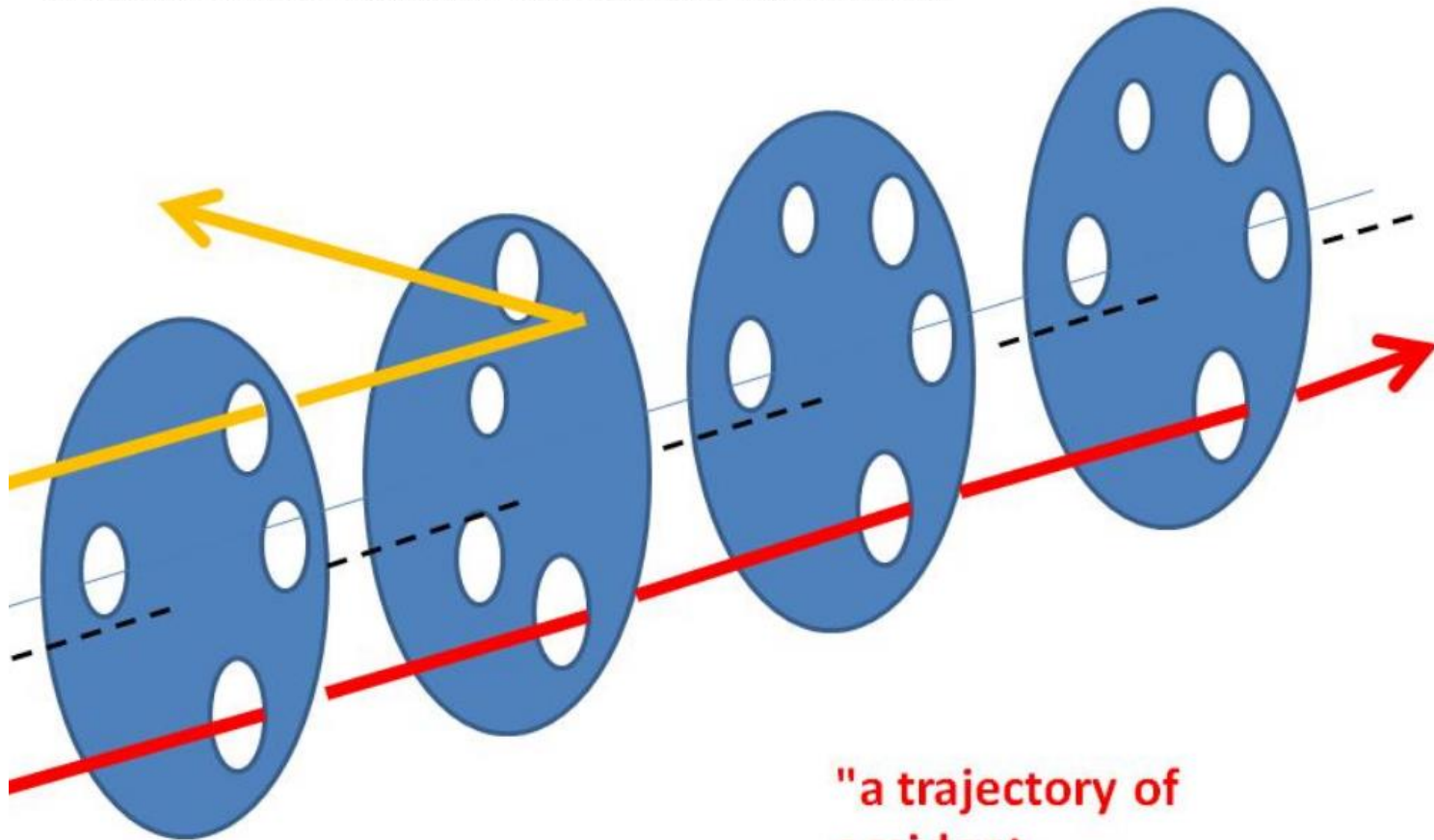
- Influences organisationnelles,
- Mauvaise supervision,
- Conditions prédisposantes aux actes dangereux,
- Les actes dangereux eux-mêmes.
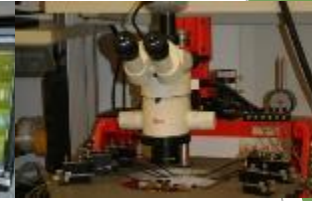
SWISS CHEESE MODEL

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Reason's Swiss Cheese Model

"a trajectory of accident opportunity"

HFACS

Human
Factor
Analysis
and
Classification
System

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HFACS

The Human Factors Analysis and Classification System (HFACS) was developed by Dr Scott Shappell and Dr Doug Wiegmann.

It can be used to investigate and analyse human factors aspects of aviation.

HFACS is heavily based upon James Reason's Swiss cheese model (Reason 1990).

The HFACS framework provides a tool to assist in the investigation process and target training and prevention efforts. Investigators are able to systematically identify active and latent failures within an organisation that led to in an accident.

The HFACS Framework
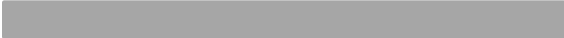
The HFACS framework describes human error
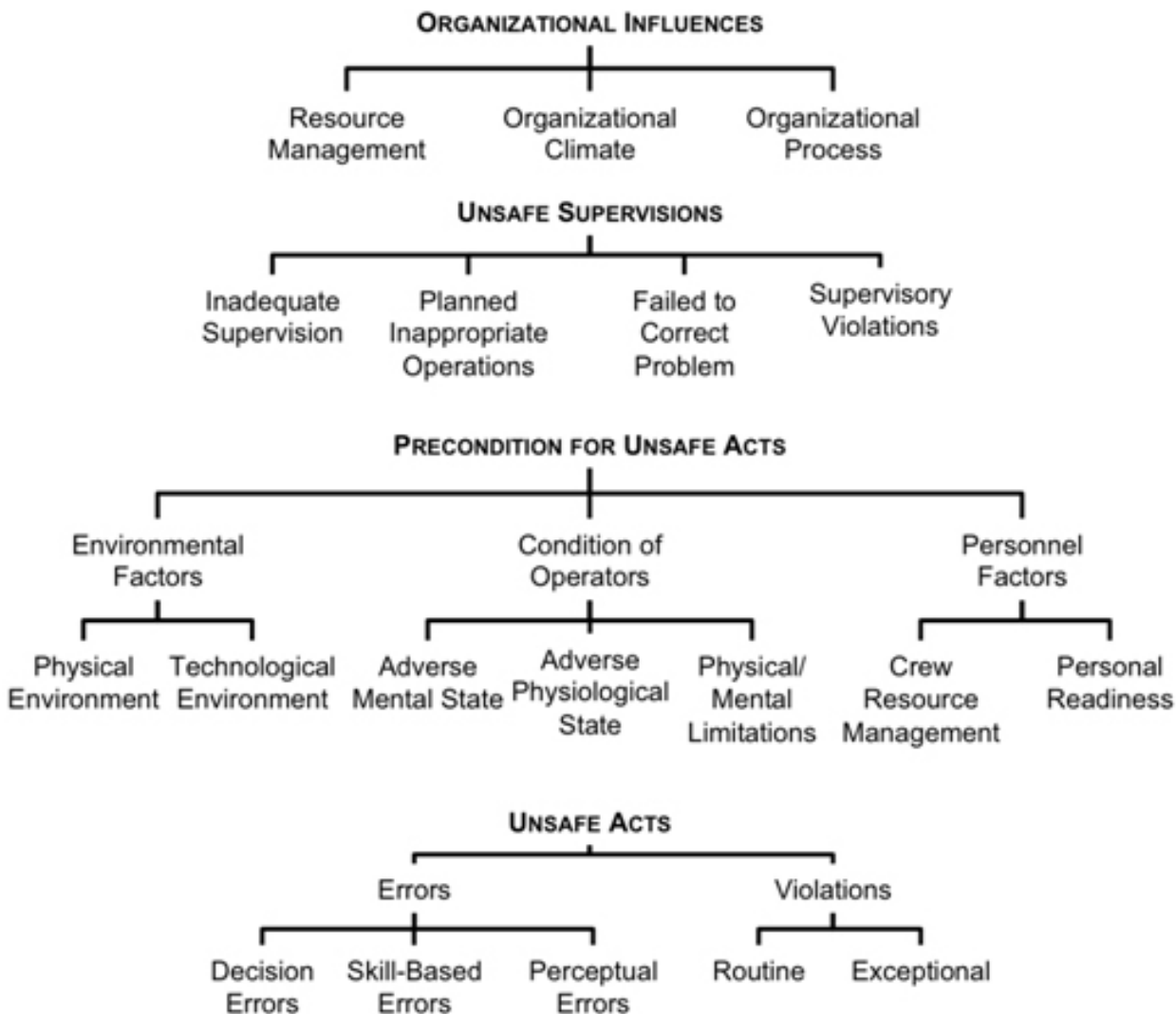
at each of four levels of failure :

1 - *Unsafe acts of operators (aircrew, controllers etc),*

2 - *Preconditions for unsafe acts,*

3 - *Unsafe supervision, and*

4 - *Organisational influences.*

Within each level of HFACS, causal categories were developed that identify the active and latent failures that occur.

In theory, at least one failure will occur at each level leading to an adverse event. If at any time leading up to the adverse event, one of the failures is corrected, the event will not happen.

The HFACS Framework

ORGANIZATIONAL INFLUENCES
- Resource Management
- Organizational Climate
- Organizational Process

UNSAFE SUPERVISIONS
- Inadequate Supervision
- Planned Inappropriate Operations
- Failed to Correct Problem
- Supervisory Violations

PRECONDITION FOR UNSAFE ACTS
- Environmental Factors
  - Physical Environment
  - Technological Environment
- Condition of Operators
  - Adverse Mental State
  - Adverse Physiological State
  - Physical/Mental Limitations
- Personnel Factors
  - Crew Resource Management
  - Personal Readiness

UNSAFE ACTS
- Errors
  - Decision Errors
  - Skill-Based Errors
  - Perceptual Errors
- Violations
  - Routine
  - Exceptional

HFACS Level 1: Unsafe Acts

The Unsafe Acts level is divided into two categories - errors and violations - and these two categories are then divided into subcategories.

- Errors are unintentional behaviors,

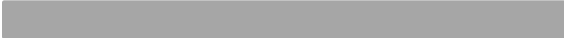- Violations are an intentional disregard of the rules and regulations.

The HFACS Framework

HFACS Level 1: Unsafe Acts

Errors

Skill-Based Errors: Errors which occur in the operator's execution of a routine, highly practiced task relating to procedure, training or proficiency and result in an unsafe situation (e.g., fail to prioritise attention, checklist error, negative habit).

Decision Errors: Errors which occur when the behaviors or actions of the operators proceed as intended yet the chosen plan proves inadequate to achieve the desired end-state and results in an unsafe situation (e.g, exceeded ability, rule-based error, inappropriate procedure).

Perceptual Errors: Errors which occur when an operator's sensory input is degraded and a decision is made based upon faulty information.

HFACS Level 1: Unsafe Acts

Violations

• Routine Violations: Violations which are a habitual action on the part of the operator and are tolerated by the management /hierarchy.

• Exceptional Violations: Violations which are an isolated act, neither typical of the person, nor accepted by the management.

TABLE 1. Selected examples of Unsafe Acts of Pilot Operators (Note: This is not a complete listing)

ERRORS	VIOLATIONS
Skill-based Errors	Failed to adhere to brief
Breakdown in visual scan	Failed to use the radar altimeter
Failed to prioritize attention	Flew an unauthorized approach
Inadvertent use of flight controls	Violated training rules
Omitted step in procedure	Flew an overaggressive maneuver
Omitted checklist item	Failed to properly prepare for the flight
Poor technique	Briefed unauthorized flight
Over-controlled the aircraft	Not current/qualified for the mission
Decision Errors	Intentionally exceeded the limits of the aircraft
Improper procedure	Continued low-altitude flight in VMC
Misdiagnosed emergency	Unauthorized low-altitude canyon running
Wrong response to emergency	
Exceeded ability	
Inappropriate maneuver	
Poor decision	
Perceptual Errors (due to)	
Misjudged distance/altitude/airspeed	
Spatial disorientation	
Visual illusion	

HFACS Level 2: Preconditions for Unsafe Acts

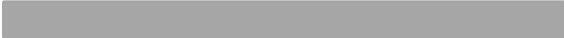The *Preconditions for Unsafe Acts* level is divided into three categories:

- *Environmental factors*

- *Condition of operators*

- *Personnel factors.*

HFACS Level 2: Preconditions for Unsafe Acts

Environmental Factors

❑ **Physical Environment:** Refers to factors that include both the operational setting (e.g., weather, altitude, terrain) and the ambient environment (e.g., heat, vibration, lighting, toxins).

❑ **Technological Environment:** Refers to factors that include a variety of design and automation issues including the design of equipment and controls, display/interface characteristics, checklist layouts, task factors and automation.

Condition of the operator

- ❑ **Adverse Mental State**: Refers to factors that include those mental conditions that affect performance (e.g., stress, mental fatigue, motivation).

- ❑ **Adverse Physiological State**: Refers to factors that include those medical or physiological conditions that affect performance (e.g, medical illness, physical fatigue, hypoxia).

- ❑ **Physical/Mental Limitations**: Refers to the circumstance when an operator lacks the physical or mental capabilities to cope with a situation, and this affects performance (e.g., visual limitations, insufficient reaction time).

Personal factors

- ❑ **Crew Resource Management:** Refers to factors that include communication, coordination, planning, and teamwork issues.

- ❑ **Personal Readiness:** Refers to off-duty activities required to perform optimally on the job such as adhering to crew rest requirements, alcohol restrictions, and other off-duty mandates

TABLE 2. Selected examples of Unsafe Aircrew Conditions (Note: This is not a complete listing)

SUBSTANDARD CONDITIONS OF OPERATORS	SUBSTANDARD PRACTICE OF OPERATORS
Adverse Mental States	**Crew Resource Management**
Channelized attention	Failed to back-up
Complacency	Failed to communicate/coordinate
Distraction	Failed to conduct adequate brief
Mental fatigue	Failed to use all available resources
Get-home-itis	Failure of leadership
Haste	Misinterpretation of traffic calls
Loss of situational awareness	**Personal Readiness**
Misplaced motivation	Excessive physical training
Task saturation	Self-medicating
Adverse Physiological States	Violation of crew rest requirement
Impaired physiological state	Violation of bottle-to-throttle requirement
Medical illness	
Physiological incapacitation	
Physical fatigue	
Physical/Mental Limitation	
Insufficient reaction time	
Visual limitation	
Incompatible intelligence/aptitude	
Incompatible physical capability	

The Unsafe Supervision level is divided into four categories.

- ☐ · Inadequate Supervision
- ☐ · Plan Inappropriate Operation
- ☐ · Fail to Correct Known Problem
- ☐ · Supervisory Violation

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Inadequate supervision

The role of any supervisor is to provide their staff with the opportunity to succeed, and they must provide guidance, training, leadership, oversight, or incentives to ensure the task is performed safely and efficiently.

Plan inappropriate operation

Refers to those operations that can be acceptable and different during emergencies, but unacceptable during normal operation (e.g., risk management, crew pairing, operational tempo).

Fail to Correct Known Problem

Refers to those cases when deficiencies are known to the supervisor, yet are allowed to continue not corrected

Supervisory violation

Refers to those cases when deficiencies are known to the supervisor, yet are allowed to continue not corrected

TABLE 3. Selected examples of Unsafe Supervision (Note: This is not a complete listing)

Inadequate Supervision

Failed to provide guidance

Failed to provide operational doctrine

Failed to provide oversight

Failed to provide training

Failed to track qualifications

Failed to track performance

Planned Inappropriate Operations

Failed to provide correct data

Failed to provide adequate brief time

Improper manning

Mission not in accordance with rules/regulations

Provided inadequate opportunity for crew rest

Failed to Correct a Known Problem
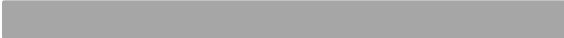
Failed to correct document in error

Failed to identify an at-risk aviator

Failed to initiate corrective action

Failed to report unsafe tendencies

Supervisory Violations

Authorized unnecessary hazard

Failed to enforce rules and regulations

Authorized unqualified crew for flight

The Organisational Influences level is divided into three categories.

➢ Resource Management

➢ Organisational Climate

➢ Operational Process

Resource management

Refers to the organisational-level decision-making regarding the allocation and maintenance of organisational assets (e.g., human resources, monetary/budget resources, equipment/facility recourse).

HFACS Level 4 : Organisational influences

Organisational climate

Refers to the working atmosphere within the organization.

HFACS Level 4 : Organisational influences

Operational process

Refers to organisational decisions and rules that govern the everyday activities within an organisation (e.g., operations, procedures, oversight).

Resource/Acquisition Management

Human Resources
- Selection
- Staffing/manning
- Training

Monetary/budget resources
- Excessive cost cutting
- Lack of funding

Equipment/facility resources
- Poor design
- Purchasing of unsuitable equipment

Organizational Climate

Structure
- Chain-of-command
- Delegation of authority
- Communication
- Formal accountability for actions

Policies
- Hiring and firing
- Promotion
- Drugs and alcohol

Culture
- Norms and rules
- Values and beliefs
- Organizational justice

Organizational Process

Operations
- Operational tempo
- Time pressure
- Production quotas
- Incentives
- Measurement/appraisal
- Schedules
- Deficient planning

Procedures
- Standards
- Clearly defined objectives
- Documentation
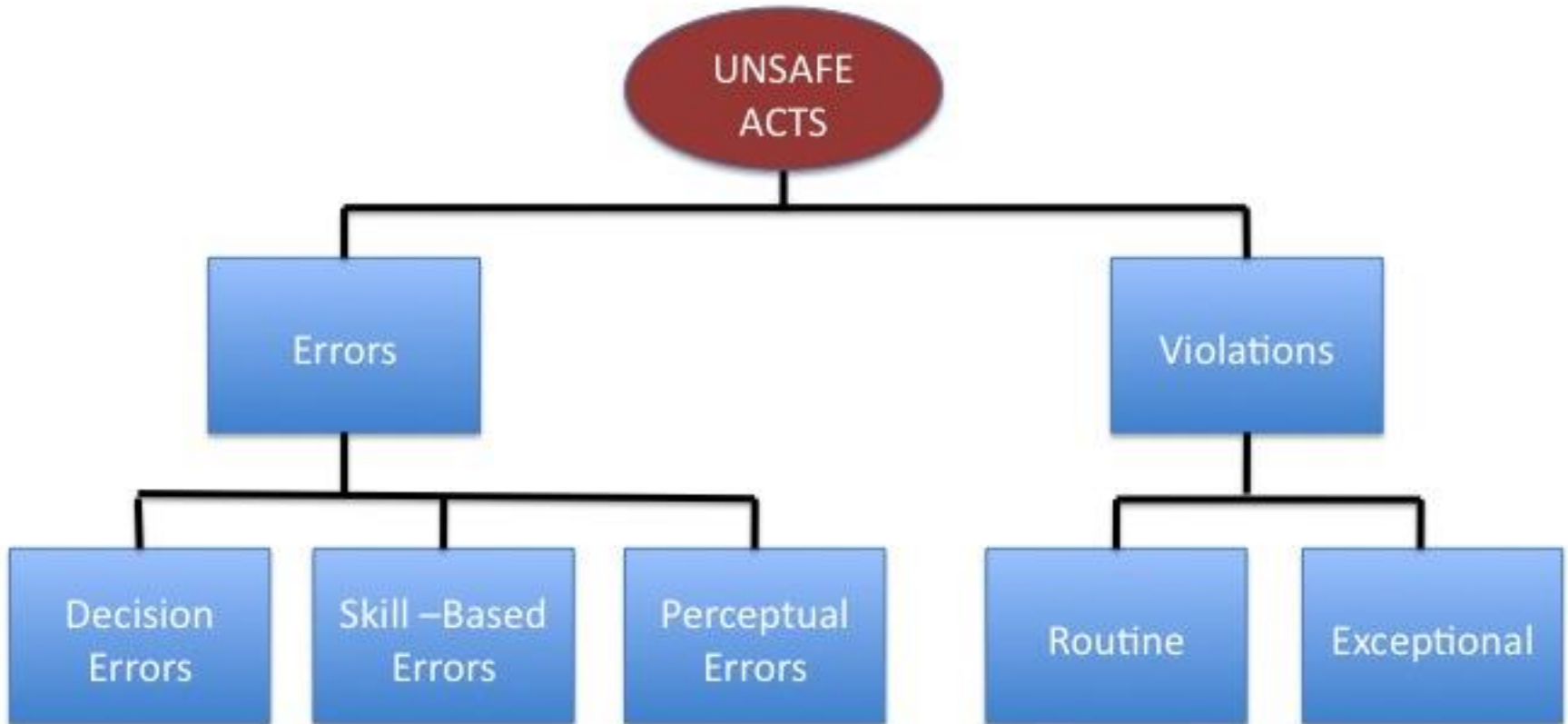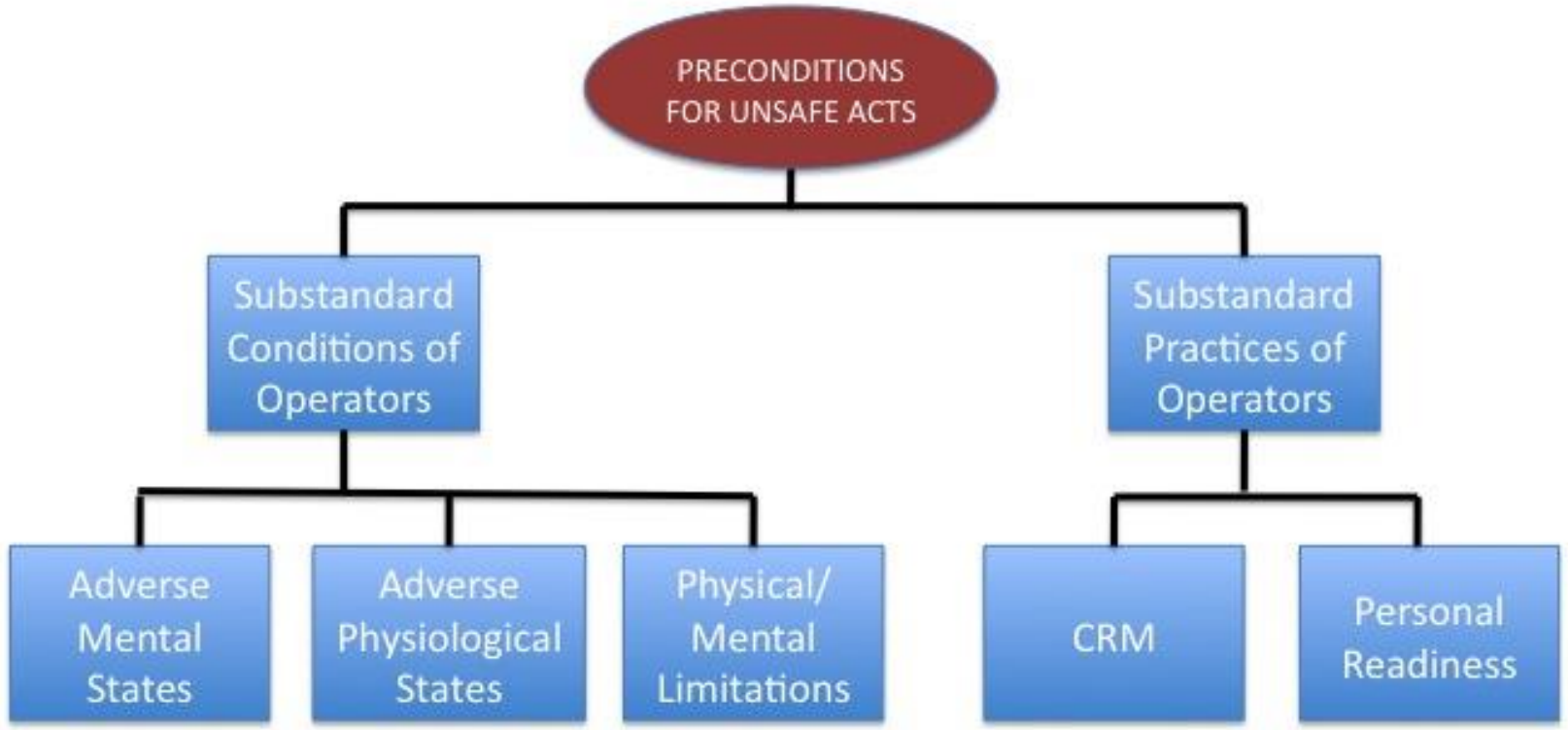- Instructions

Oversight
- Risk management
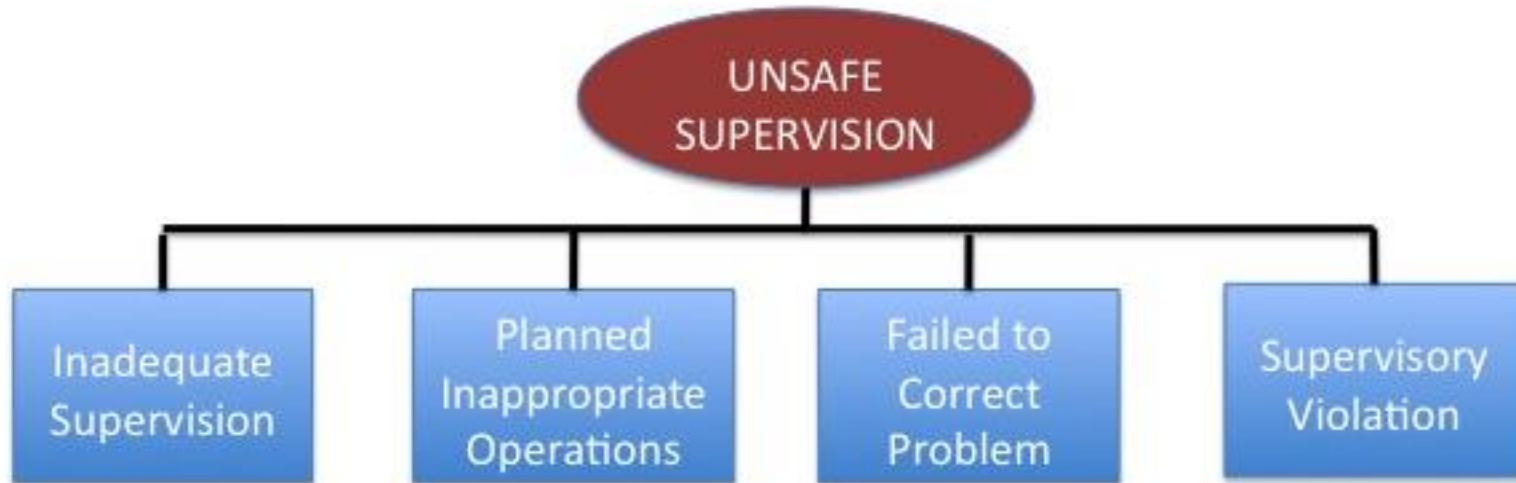- Safety programs

SUMMARY

HFACS Level 1: Unsafe Acts

USE OF FACTS

USE OF FACTS

HFACS provides a structure to review and analyze accident and safety data.

It enables the analyst to identify the factors that are associated with an unsafe event.

The HFACS framework may also be useful as a tool for guiding future accident investigations in the field and for developing better accident databases, both of which would improve the overall quality and accessibility of human factors accident data.

By using HFACS, an organisation can identify hazards and implement procedures to prevent these hazards which will result in improved human performance and decreased accident and injury rates.

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EXERCICEs

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**THANK YOU
DO YOU HAVE ANY QUESTIONS ?**