Flight Safety Foundation

An International Organization for Everyone Concerned with the Safety of Flight

Operators Guide to Human Factors in Aviation

An Introduction to Threat and Error Management

This presentation provides information and guidance to help improve decision making. It is intended to enhance the reader's awareness but it shall not supersede the applicable regulations or airline's operational documentation; should any deviation appear between this presentation and the airline's AFM / (M)MEL / FCOM / QRH / FCTM, the latter shall prevail at all times.

Threat and Error Management

Threat and Error Management (TEM) is the safety concept concerned with threats to safe flight and the reduction of human error in daily operations.

This visual guide introduces Threat and Error Management.
Subsequent visual guides provide detailed information to assist :-

A. an Organisation to implement a Safety Management System
B. operating Crew to manage Threats and Errors in everyday situations

This guide may be used for self study or as part of a formal training program.
There are five sections; the speaker notes provide additional information.

1. Introduction to TEM and safety management
2. Defining Threats and Errors, Undesired States
3. Strategy and Tactics for TEM
4. Safety Management Systems
5. Crew Resource Management

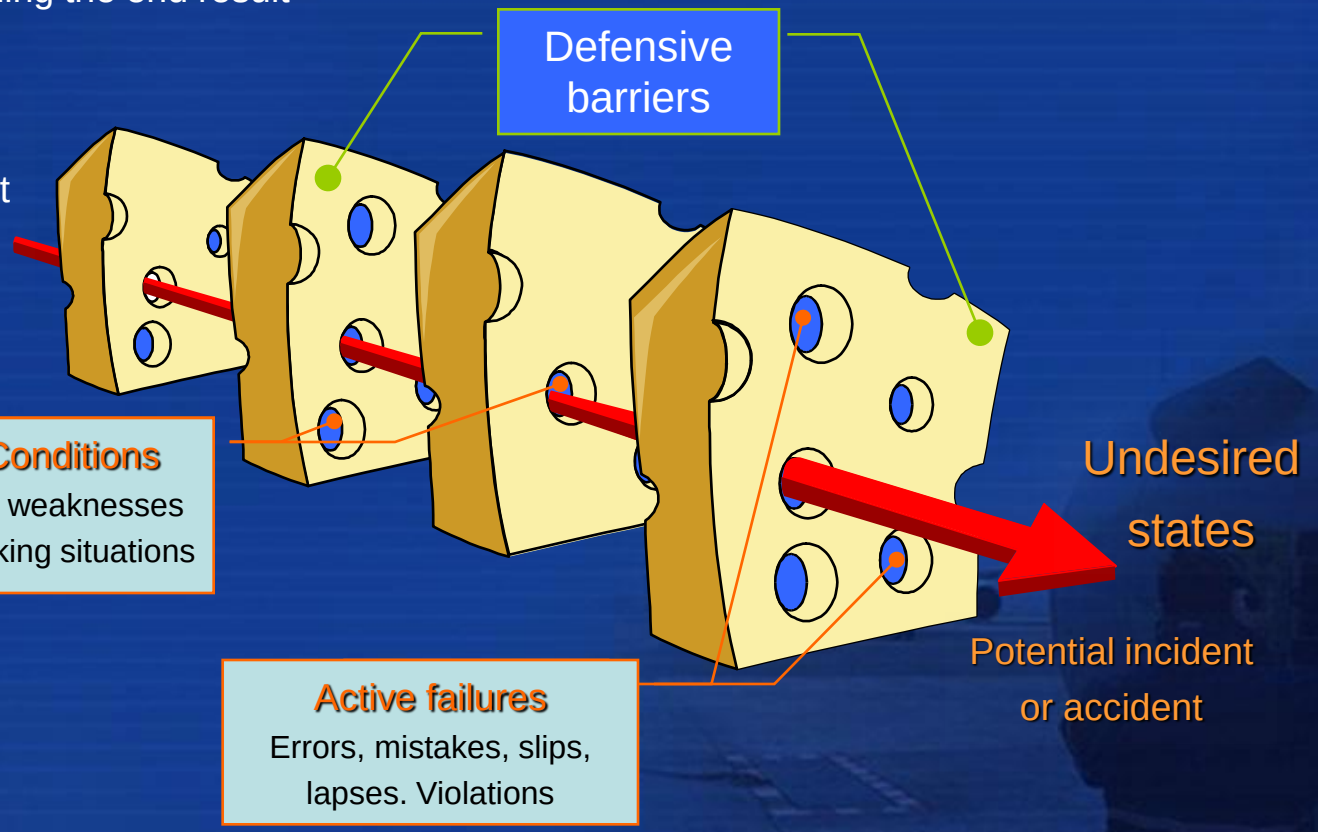
Threat Management is managing your future
Error Management is managing your past

Speakers notes provide additional information, they can be selected by clicking the right mouse button **in Slideshow View**, select Screen, select Speakers notes.
This presentation can be printed in the notes format to provide a personal reference document.

Introduction to TEM - safety management

TEM is central to all safety processes and provides defences against hazards in operational situations; it involves:-

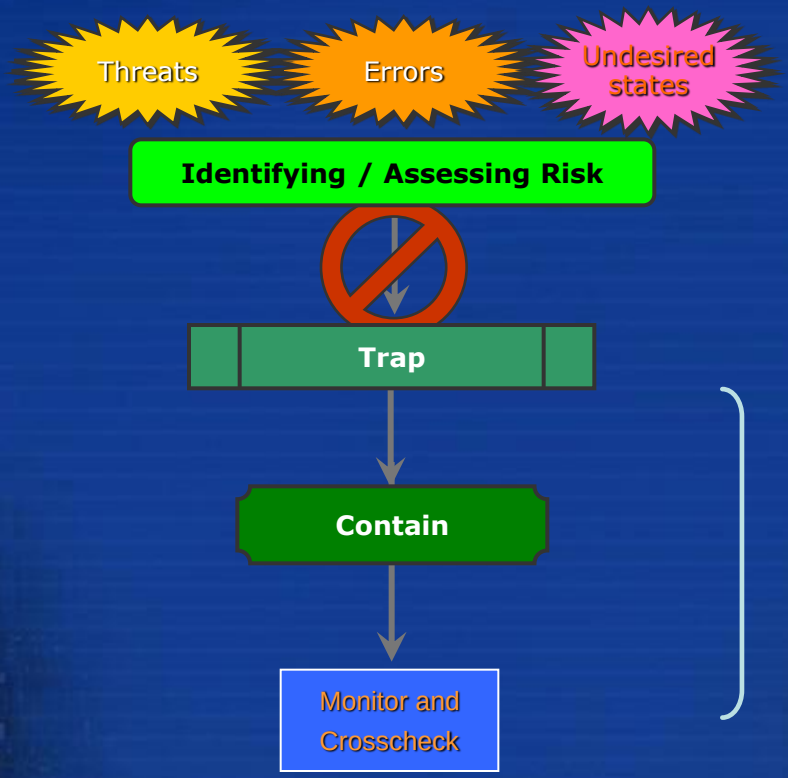
- Identifying hazards to safe flight, threats, errors, or undesired states
- Assessing the risk of these hazards (the consequence of accepting a hazard)
- Trapping latent conditions and active failures
- Containing the end result



Threat and Error Management - Avoid, Manage, Mitigate

The objectives of the management processes are:-

- To avoid threats and error provoking situations
- To managing those threats and errors that cannot be avoided
- To mitigating the consequences of managing the threats and errors



Avoid

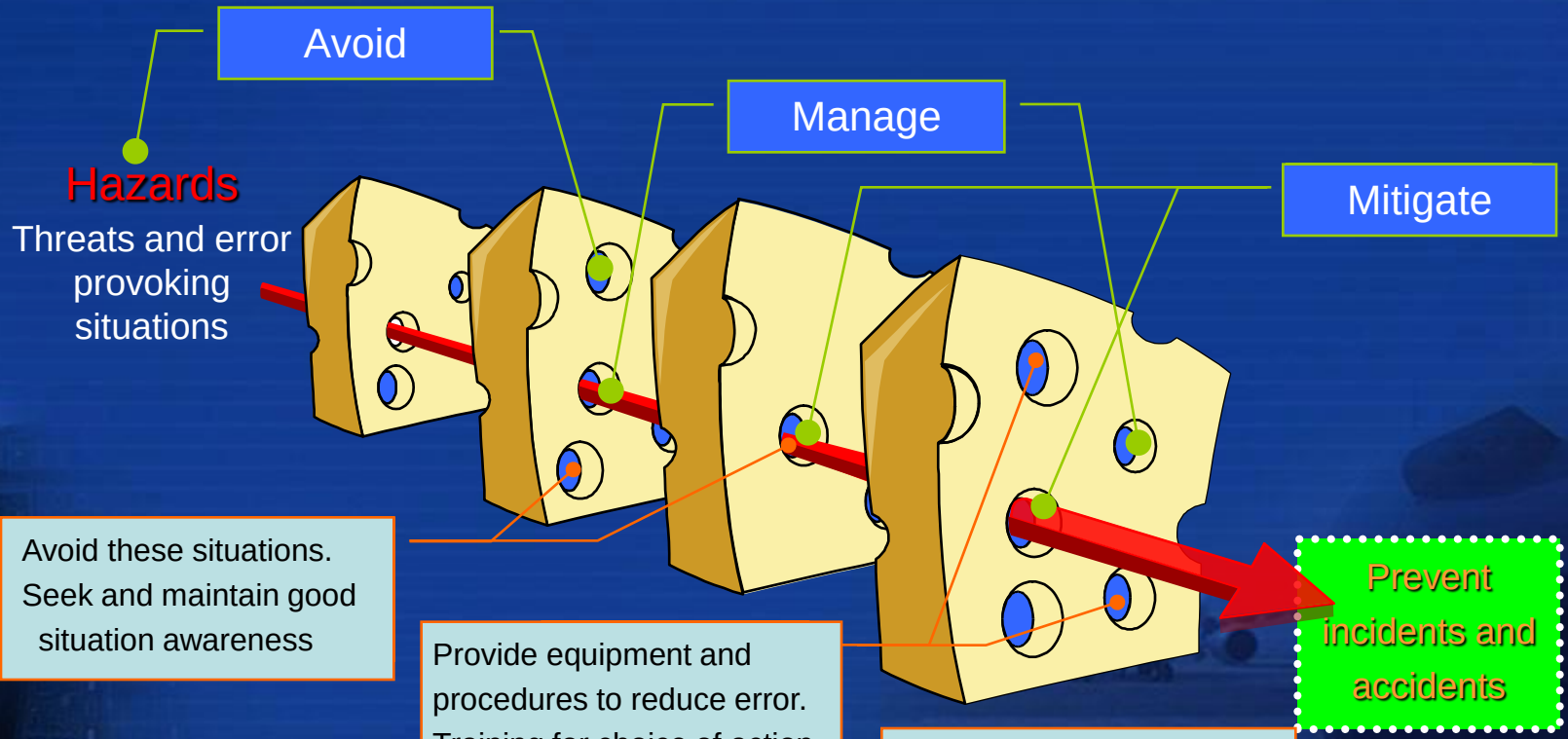
Manage

Mitigate

TEM - *Avoid, Manage, Mitigate*

The objectives of the management processes are:-

- avoiding threats and error provoking situations
- managing those threats and errors that cannot be avoided
- mitigating the consequences of managing the threats and errors



Definitions

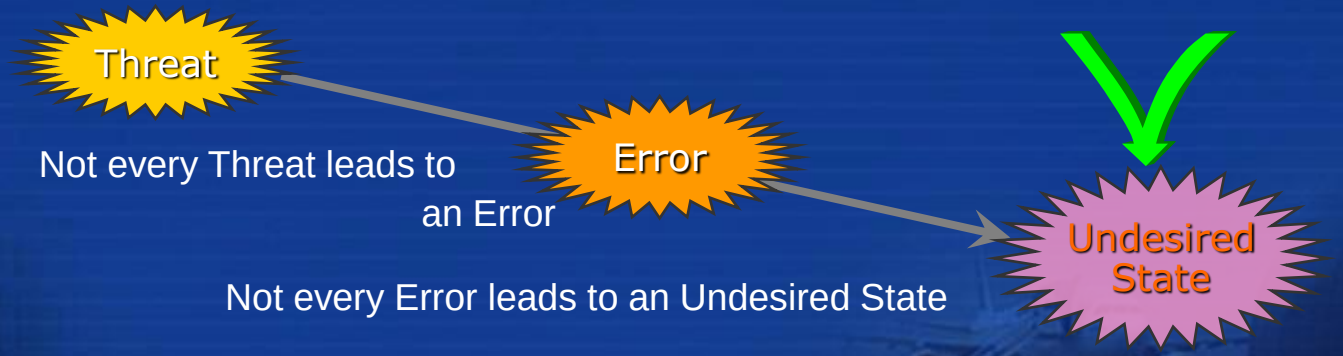
Hazard: a condition, event, or situation that could result in a reduction of safety.

Threat: a situation that is generally outside the influence of the crew and increases the risks of a flight; threats requires attention.

Error: an action or inaction that results in an unexpected outcome, reduces safety margins, and increases the probability of undesired states.

Undesired State: any aircraft condition or situation that reduces safety.

- A mismanaged Threat often leads to an Error
- A mismanaged Error often leads to Undesired State
- An Undesired State is often an indication of an Error or mismanaged Threat



Not every Threat leads to an Error

Not every Error leads to an Undesired State

Not every Undesired State is preceded by a Threat or Error

…. but when there is an undesired state

managing it is the # 1 priority

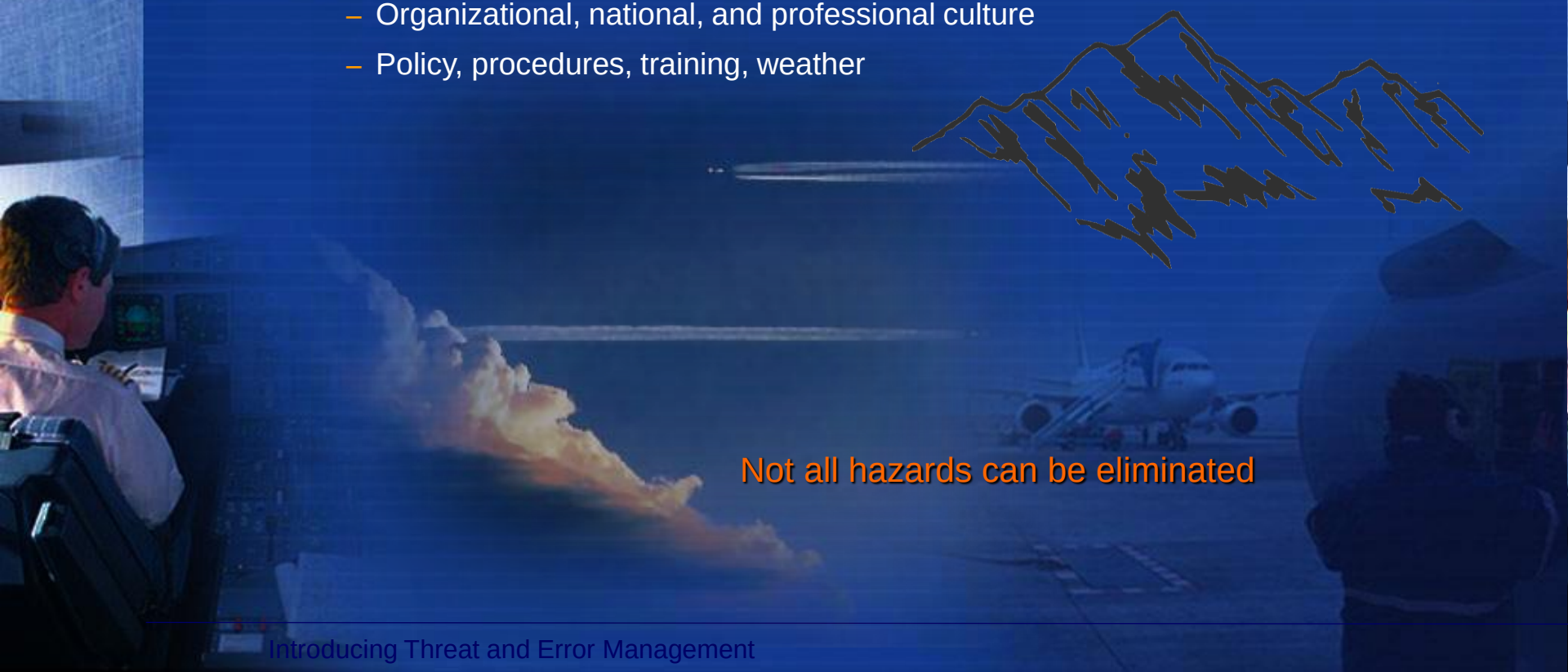
Threat

Threat - a situation that is generally beyond the influence of the crew or operator and increases the risk of safe flight. Threats change the complexity of tasks, reduce safety margins, and can lead to undesired states.

Any factor which reduces the operator's ability to work safely.

Error provoking conditions, expected, and unexpected situations

- Design, manufacture, regulations, operations, scheduling
- Organizational, national, and professional culture
- Policy, procedures, training, weather

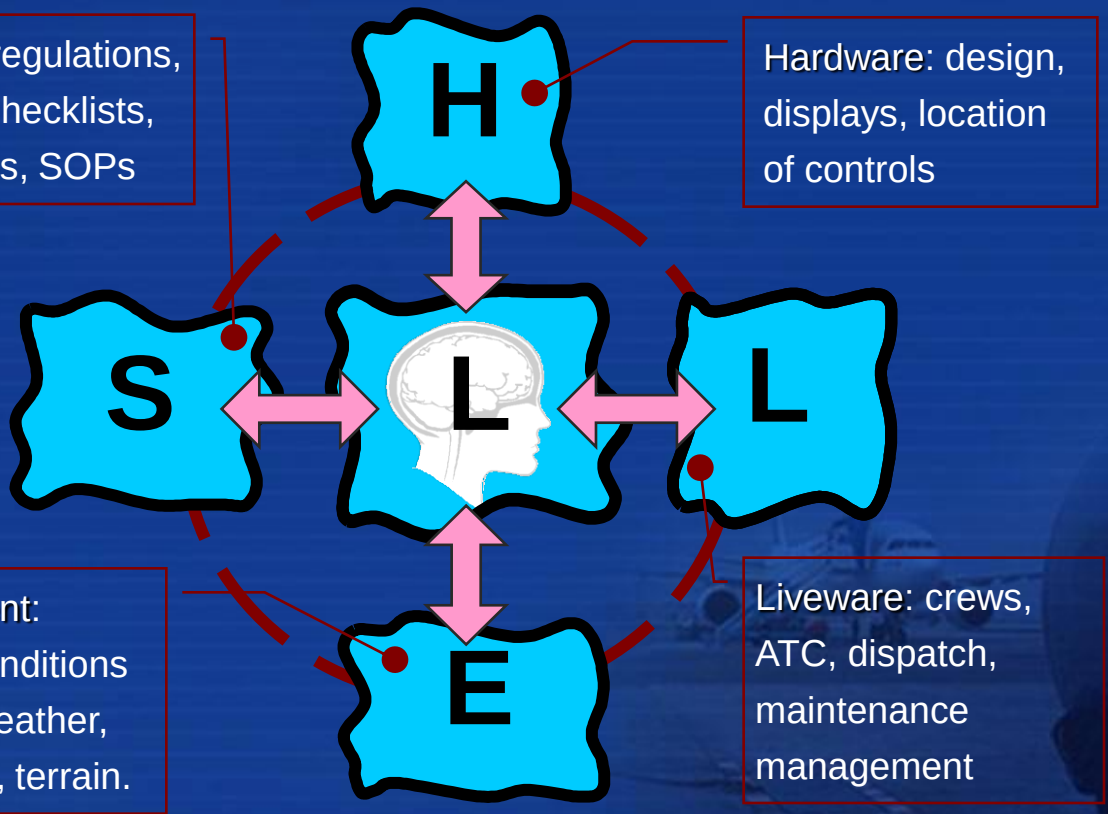


Not all hazards can be eliminated

Threats – Increase the risk in operations

Components of daily operations:-

- Threats must be identified with proactive reviews before they are encountered.
- Threats constantly change with situation and organisation changes.
- Threats are precursors to accidents and incidents.
- Threats are the breeding ground for errors.



Error

Error - an action or inaction that results in an unexpected outcome; they reduce safety margins, and increases the probability of an undesired state.

- Humans are imperfect, errors are a common, they are part of every human activity.
- Humans occasionally mismanage or incorrectly assess tasks or situational factors, and fail to achieve a compromise between completing a task and safety.
- Human errors may increase risk or reduce safety, but the human ability to adapt to changing situations makes people one of the most important lines of defence in preventing an incident or accident.

"It is often the best people who make the worst mistakes; error is not the monopoly of an unfortunate few."

"Errors…are created and provoked by workplace and 'up stream' organizational factors.

Identifying an error is merely the beginning of the search for accident causes, not the end."

Professor James Reason

A mistake is just another way of doing something

Errors – are unexpected outcomes

Errors originate from people (Liveware) and their interfaces with the human factors components in operational situations.

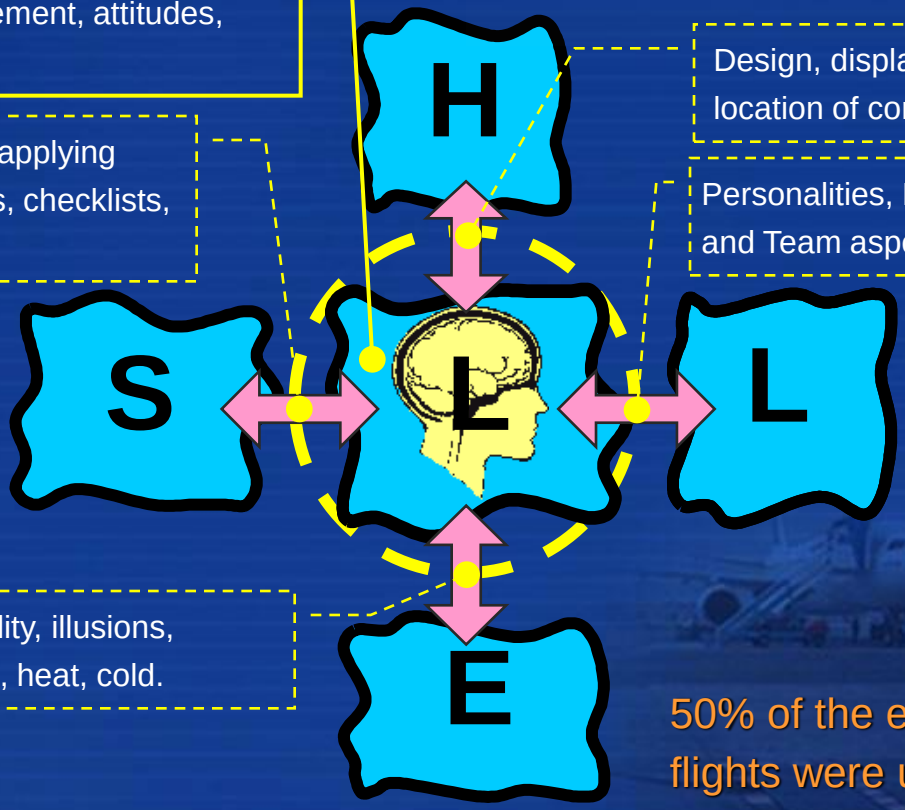
Liveware: physical and thinking abilities, health, fitness, stress, fatigue, training. Knowledge and experience, workload, motivation and judgement, attitudes, personal problems.

- Operational situations provide opportunity for error
- They enable traps - error provoking situations
- Errors reduce the margin of safety

Misinterpreting / misapplying regulations, manuals, checklists, publications, SOPs

Design, displays, location of controls

Personalities, Individual and Team aspects



Poor visibility, illusions, turbulence, heat, cold.

50% of the errors observed in flights were undetected ! LOSA

Undesired States

Undesired States:- any condition or situation that reduces safety

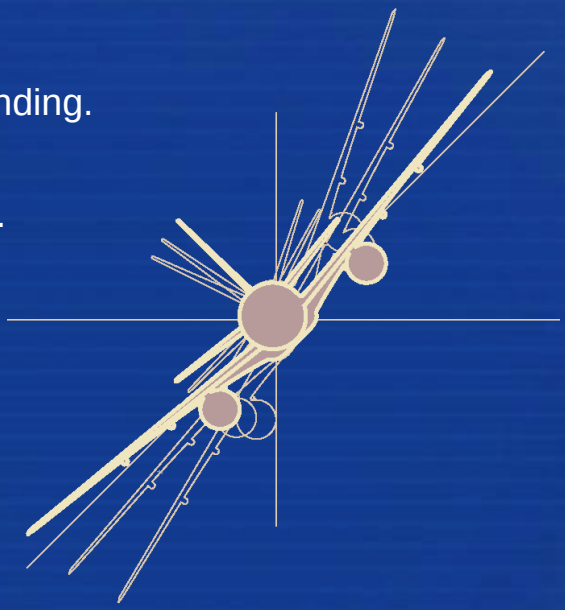
Operational Examples:-

TAWS warning, sudden upset, unstable approach, fast landing.

Organizational contributions:-

Weak training, inaccurate procedures, poor safety culture.

Managing undesired states is everyone's responsibility



Organisation and management

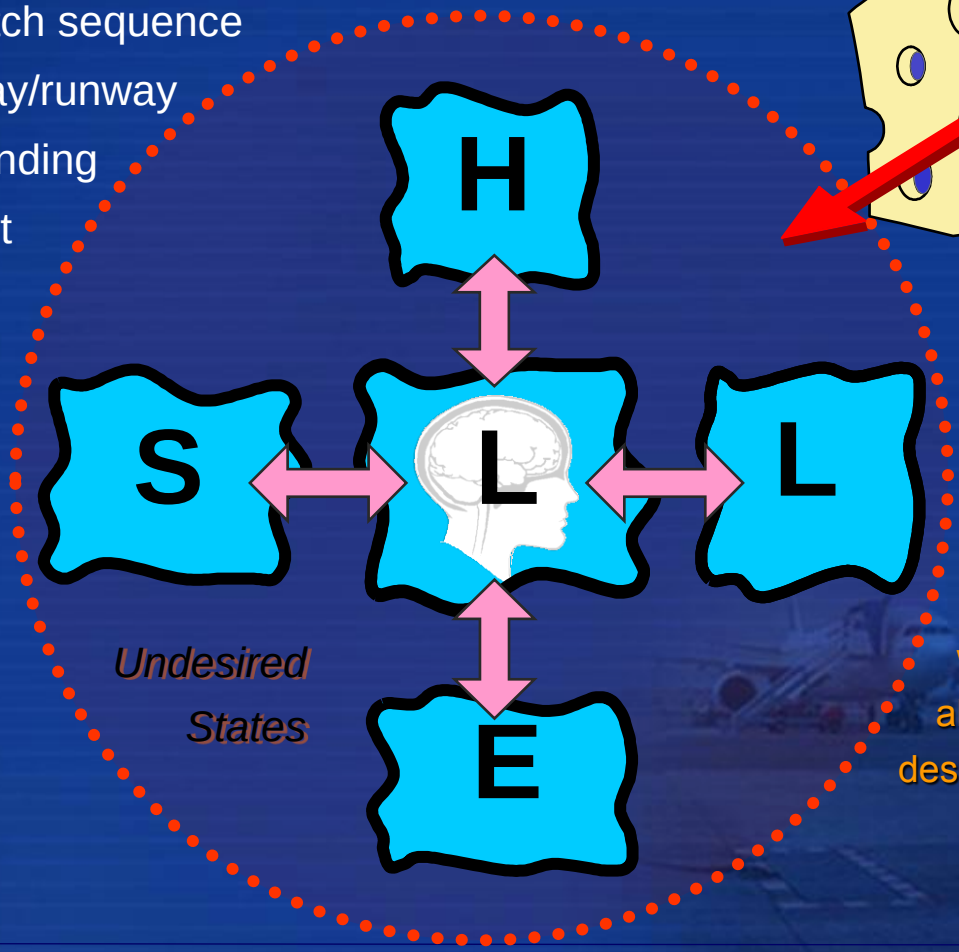
Operational conditions or situations

Inappropriate action (or inaction) in an undesired state can lead to additional error, an incidents, or accident.

Undesired States

– "as close to an accident as you ever want to get"

- Inadequate checking / cross monitoring
- TAWS, TCAS, Windshear warning
- Incorrect switch sequence
- Wrong taxiway/runway
- Fast / long landing
- Wrong Airport
- QNH not set
- Assumption



"During the pull up the aircraft cleared terrain by 160ft, which previously was above the aircraft's descending flight path".

TEM - *strategy and tactics*

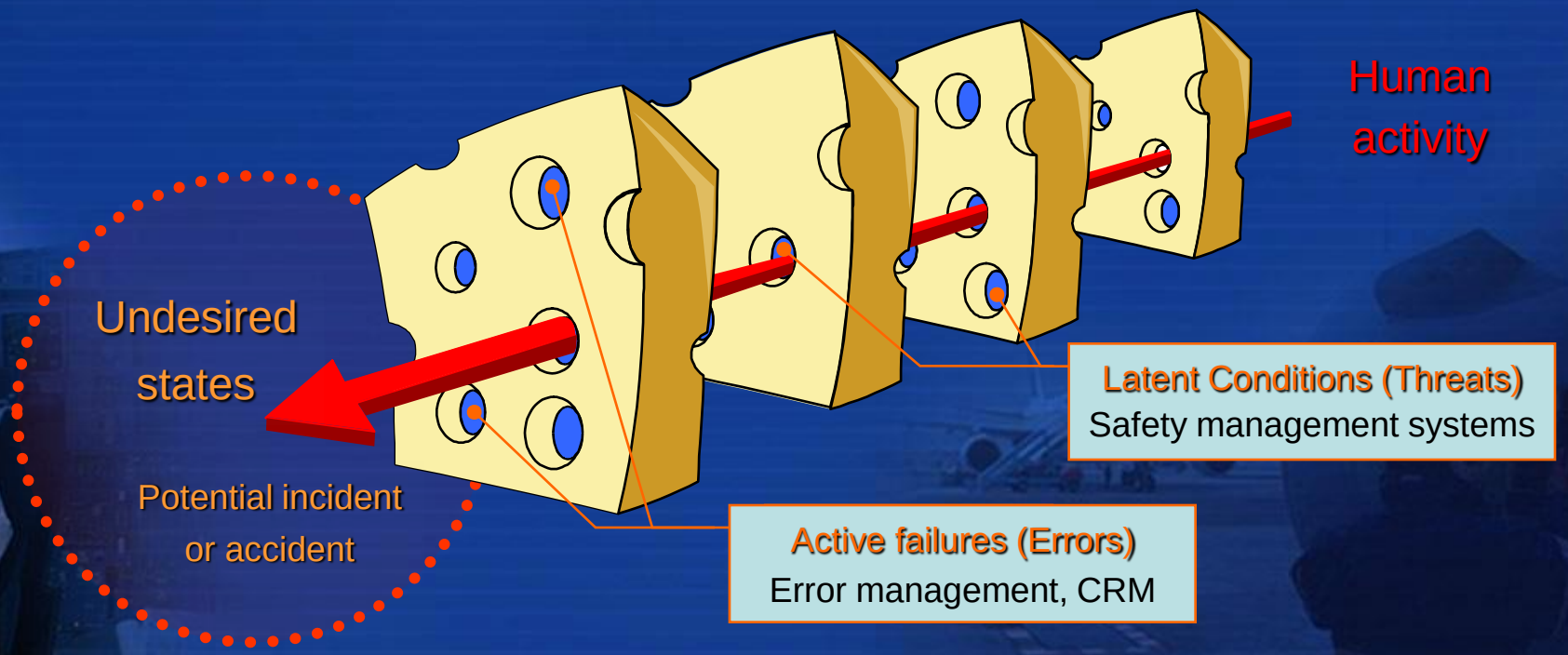
Undesired states originate from two areas of human activity:-

those involving individuals at 'the sharp end' (active failures)

those involving organisations and management (latent conditions)

Defensive barriers are a combination of safety management activities in both areas, and include:-

- strategic TEM – use of a safety management system focussed on latent conditions
- tactical TEM – use of specific crew resource management principles to reduce error



Strategic TEM - a safety management system

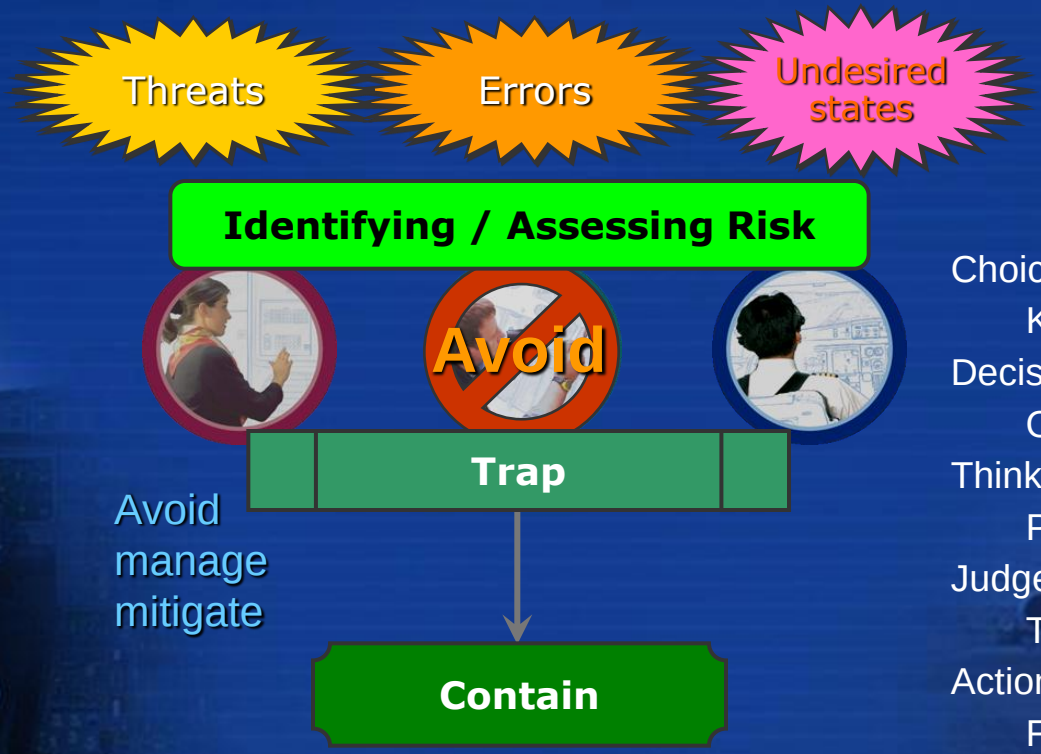
Safety is a condition in which the risk of harm or damage is limited to an acceptable level. TEM is a safety tool which helps limit risk.

Threats and errors (hazards) which generate risk must be identified, assessed, and if required suitable defences or controls put in place.

*Tactical TEM - aspects of crew resource management **

Operational threat and error management involves:-

- Identifying hazards to safe flight – error avoidance
- Threat Management – assessing the risk of the threat
- Error management – detecting, correcting (trapping) errors
- Containing the result – managing undesired states, recovery to a safe situation



Situation awareness
Attention, vigilance, scan
Risk assessment
Consequences, attitudes
Choice selection
Knowledge, information
Decision making
Objective, projecting
Thinking ahead
Plan, communication
Judgement
Thoughtful and safe
Action
Feedback, monitoring

* The crew Threat and Error Management Model is explained in the operational visual guide for TEM

TEM - practical application of human factors

Managing threats and errors depends the situation, risk, and motivation.

Operating crews generally have to manage threats and errors as they are detected, this involves predominantly reactive activities.

… but crews must be forward thinking.

- Situation awareness
- Planning and briefing
- Monitoring, checking
- Following SOPs

An organisation must be proactive in identifying hazards and assessing risks. Everyone should actively seek out threats and error provoking situations.

… but organisations must also be reactive – take action

- Audits, reviews
- Reporting
- Risk assessment
- Rules and procedures
- Training, safety culture

"Honest and critical self-assessment is one of the most powerful tools that management can employ to measure flight safety margins."

- Flight Safety Foundation Icarus Committee

Summary

Threat and Error Management involves identifying the hazards to safe flight, the assessment of risk, and the reduction of human error by managing those threats and errors in daily operations.

Strategic TEM - latent conditions

Proactive

Safety management system

Tactical TEM - active failures

Reactive

Crew resource management

It need not be necessary to suffer a 'corporate near-death' experience before acknowledging the threat of operational dangers. J. Reason

Epilogue - *Threat and Error Management is an active process*

A management team had four members called Everybody, Somebody, Anybody and Nobody.

An audit was to be done:-

Everybody was sure that Somebody would do it.

Anybody could have done it, but Nobody did it.

Somebody got angry about that because it was Everybody's job.

Everybody thought Anybody could do it but Nobody realized that Everybody wouldn't do it.

It ended up that Everybody blamed Somebody when Nobody did what Anybody could have done.