CPL Theory
Human Factors (CHUF)

CHUF 9 – Threat & Error Management (TEM)

1. Document Identification

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2. Amendment Record

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Slide	**Changes**	**Editor**	**Date (DD/MM/YY)**

3. Disclaimer

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THREATS

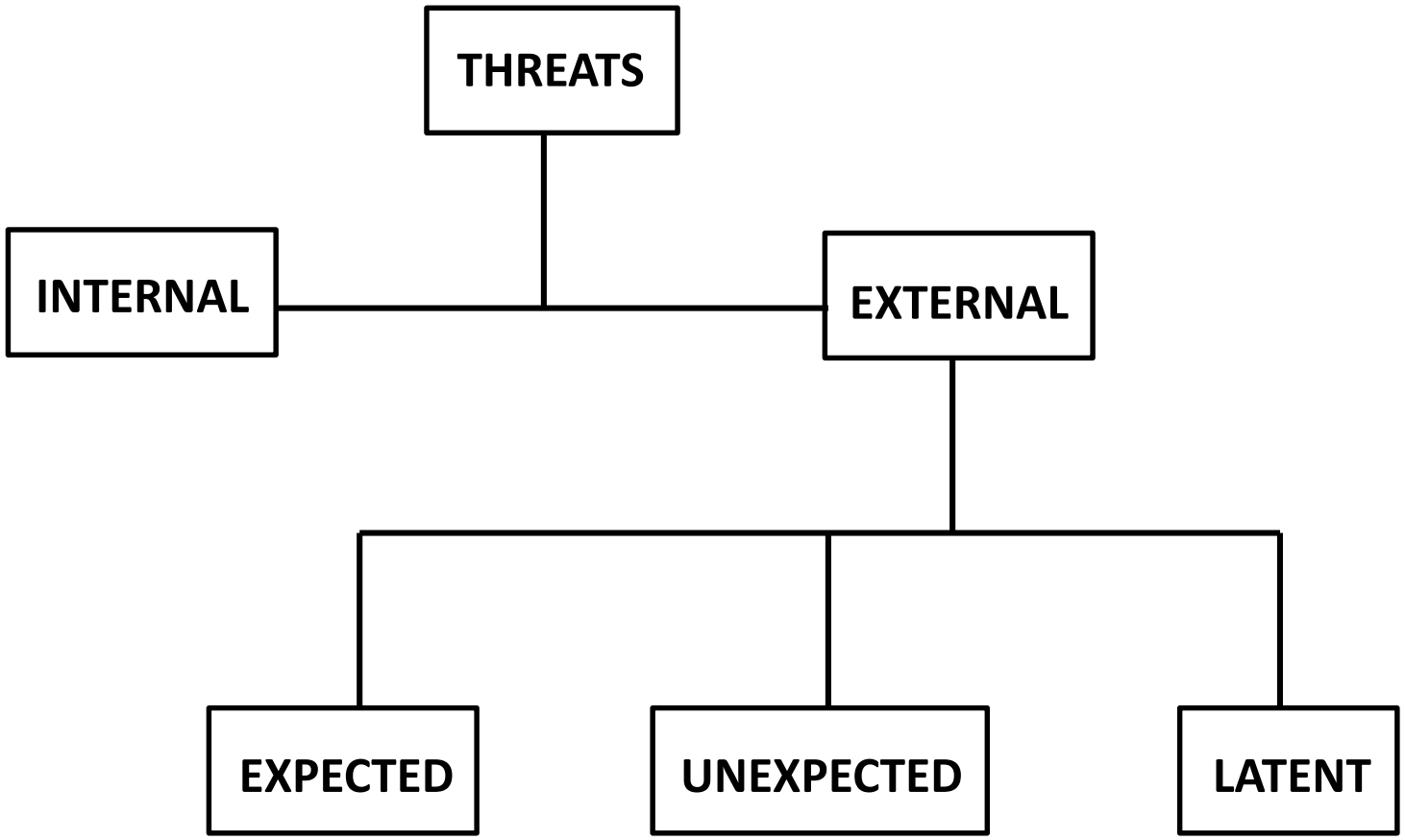
Threats

"Any situation or event that has the potential to impact negatively on flight safety. It promotes the opportunity for pilot error."

- Internal Threats (brought by the crew)
  - Pilot fatigue
  - Language/cultural barriers
  - Pilot experience & personality
  - Teamwork
  - Health & Fitness

- External Threats (from the outside environment)
  - Expected e.g. adverse weather, heavy traffic, unfamiliar aerodromes
  - Unexpected e.g. passengers, in-flight diversions
  - Latent or "hidden" threats e.g. poor cockpit design, company policy

Threats



Threats

"Any situation or event that has the potential to impact negatively on flight safety. It promotes the opportunity for pilot error."

- Organisational

  - Documentation errors (incorrect data entry/misinterpretation)

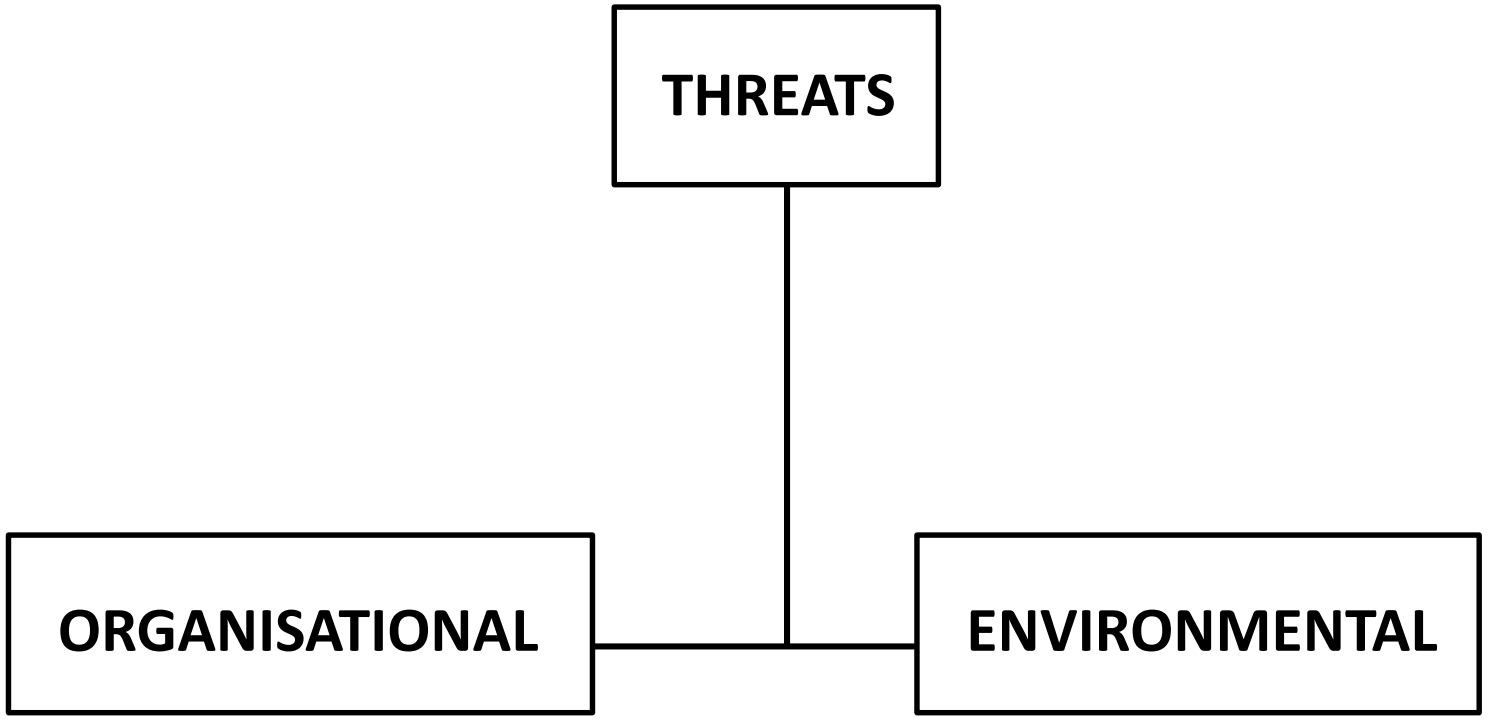
  - Tour of duty problems

- Environmental

  - Adverse weather

  - Airspace communication problems

Threats



ERRORS

Errors

"Pilot action or inaction that has a negative impact on flight safety."

- Handling Errors (error in the actual manipulation of the controls)

- Procedural Errors
  - Not using checklists
  - Not flying correct circuit direction
  - Not stopping at holding point
  - Bad instrument approach

- Communication Errors (ambiguous or misinterpreted speech)
  - Incorrect phraseology
  - Poor radio reception
  - Accents
  - Rapid speech

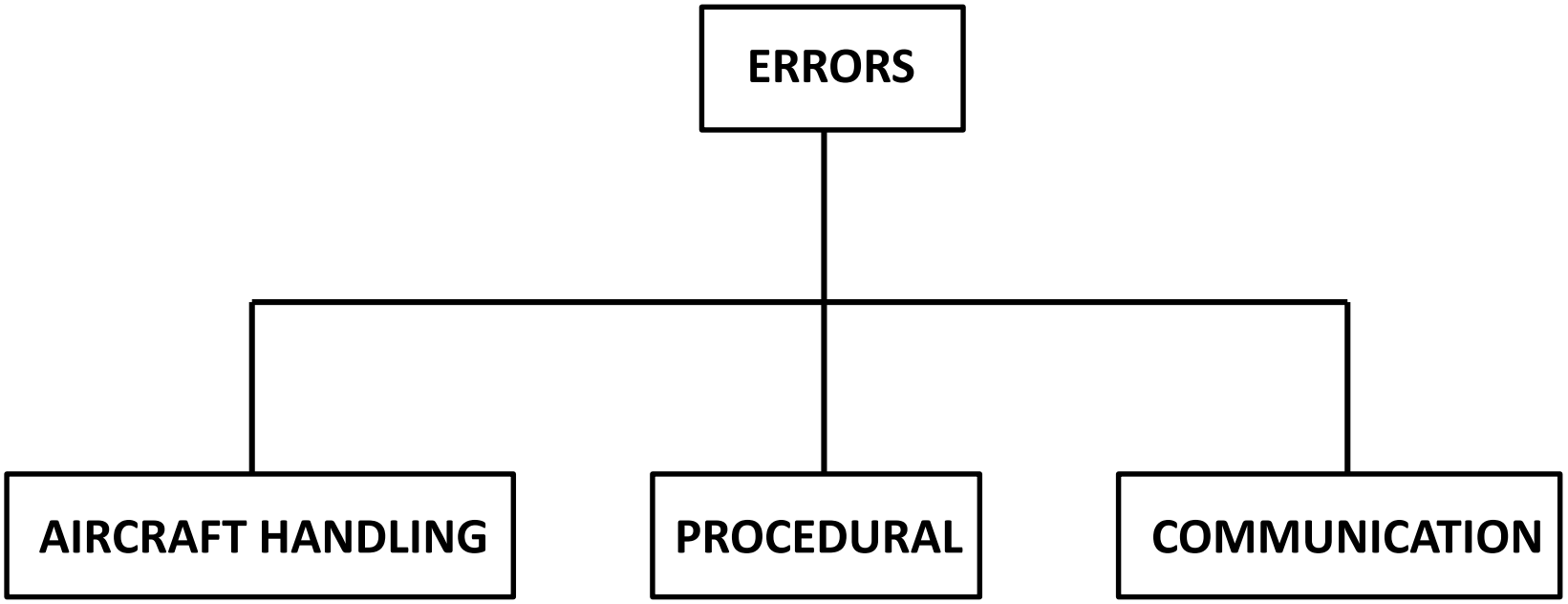
Errors

"Pilot action or inaction that has a negative impact on flight safety."

- Some funny miscommunication errors…

Captain: "Take-Off Power"	**First Officer:** *reduces power*
Captain: "Feather 4"	**First Officer:** "All at once?"
Captain: "Feather 1"	**First Officer:** "Which one?"
Captain: "Cheer up"	**First Officer:** *selects gear up*
Captain: "Yaw Damper"	**First Officer:** "My Damper"
ATC: "Say present HDG"	**First Officer:** "Present Heading"

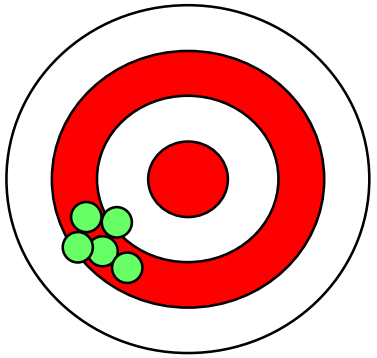
Errors



Handling Errors

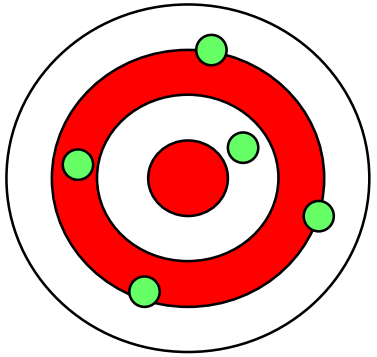
Systematic

- Student flying circuits
- Consistently landing left and short of the aim-point
- Keeps making the same mistake
- Easy to remedy – identify the problem and fix it



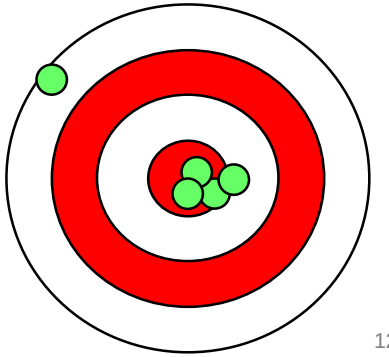
Random

- Student flying circuits
- Lands in all different areas around aim-point
- Errors are seemingly unrelated
- Common in early circuit sessions

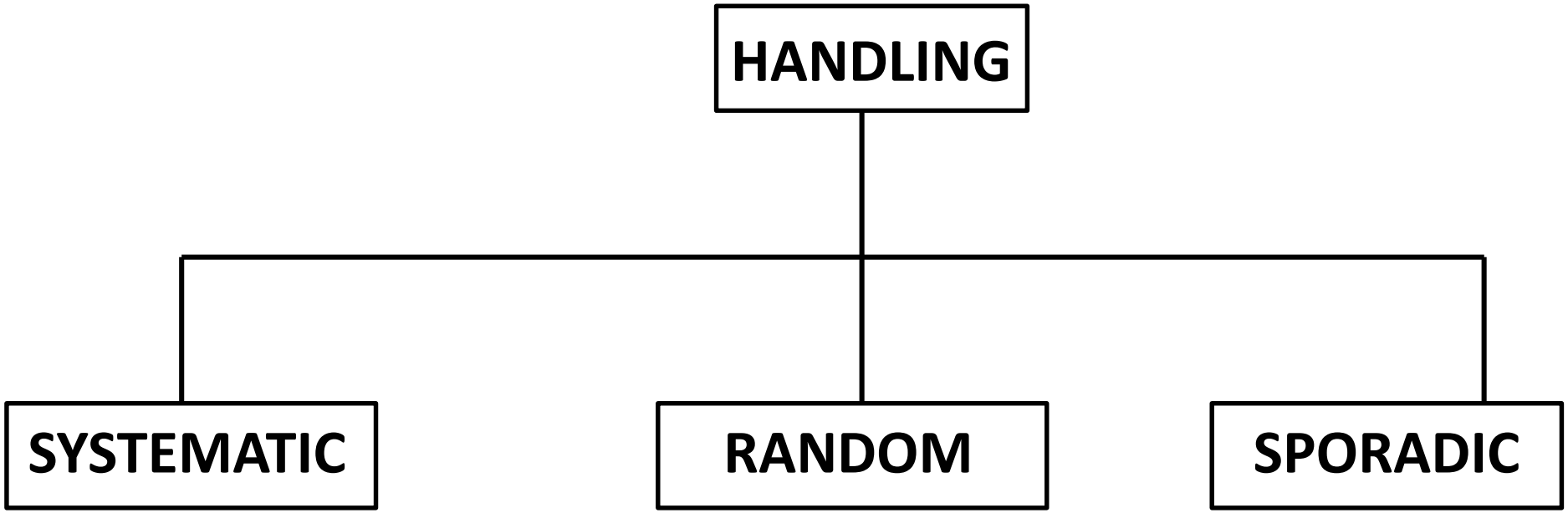


Sporadic

- Student flying circuits
- Has 4 successful landings in a row followed by 1 large error – well past and left of the aim-point
- Most difficult to remedy



Handling Errors



Errors

- Note that the definition of error was “Pilot **action** or **inaction**…”

- We can also categorise errors this way

Error of Omission

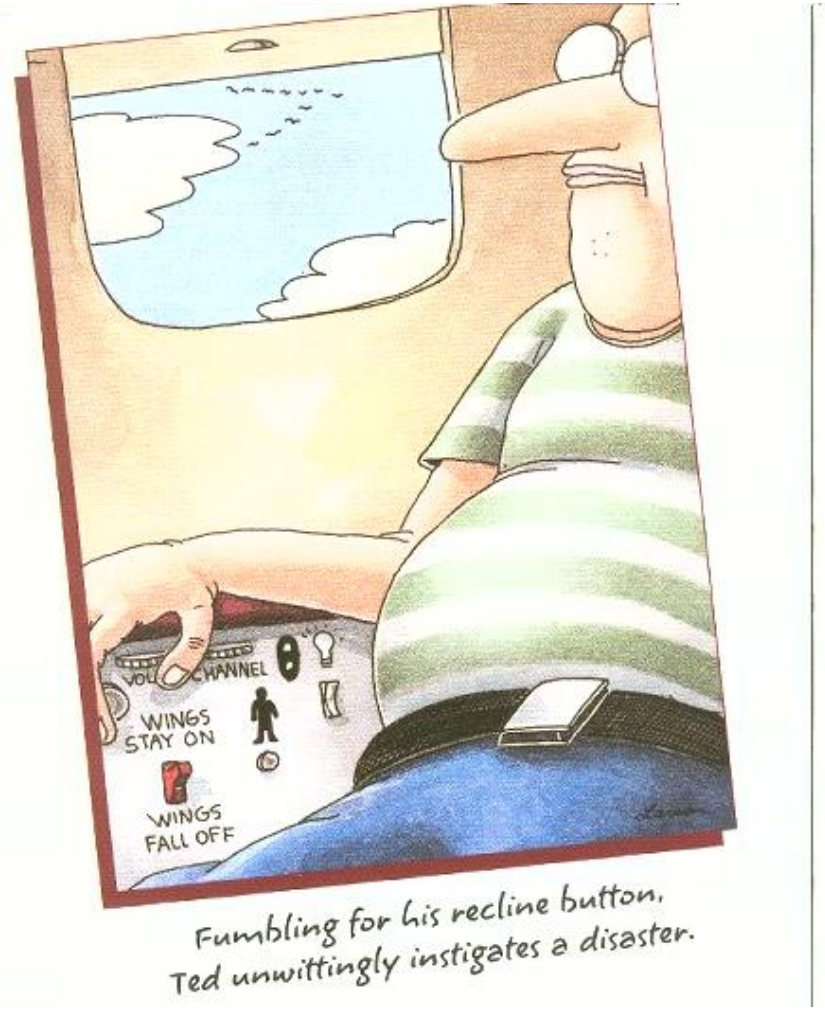
- Pilot forgets to do something which should have been done
- E.g. forgets a checklist item
- E.g. forgets to select flap on base

Error of Commission

- Pilot does something which should not have been done

Error of Substitution

- Pilot does something but should have done something else
- E.g. selecting flap instead of gear



Committed Error

- If we **expect** a particular situation to arise and prepare ourselves accordingly, we will respond more rapidly once it arises

- However, if the **opposite is what actually occurs**, we run the risk of carrying out the action we initially prepared ourselves for, even though the situation has changed

- This becomes interesting when we examine **rule based behaviour** against **knowledge based behaviour**

Committed Error

Rule Based Behaviour

- The best example of rule based behaviour is **Standard Operating Procedures (SOPs)**
- Most companies will have specific SOPs for specific emergencies
- The emergency is broken down and reduced to a **sequence of pre-planned actions** that have been carefully thought out beforehand
- When the emergency occurs, we simply follow the plan!

ENGINE FAILURE!!!!!!

- Mix UP (full rich)
- Pitch UP (fully fine)
- Power UP (fully open)
- Gear UP (retract undercarriage)
- Flap UP (retract flaps)
- Identify (failed engine)
- Confirm (failed engine)
- Feather (failed engine)

Committed Error

Knowledge Based Behaviour

- The problem with rule based behaviour is that there is **no room for variation** – the pre-planned actions are only for a **specific emergency**

- **Knowledge based behaviour** requires us to **think & reason – "sit on your hands first!"**

- Knowledge stored in the **long term memory** is used to assess all the facts

- This also requires an element of **situational awareness**, the levels of which include:

Perception

- Using the **senses** to receive information e.g. visual, auditory

Comprehension

- Using the brain to **interpret** this information

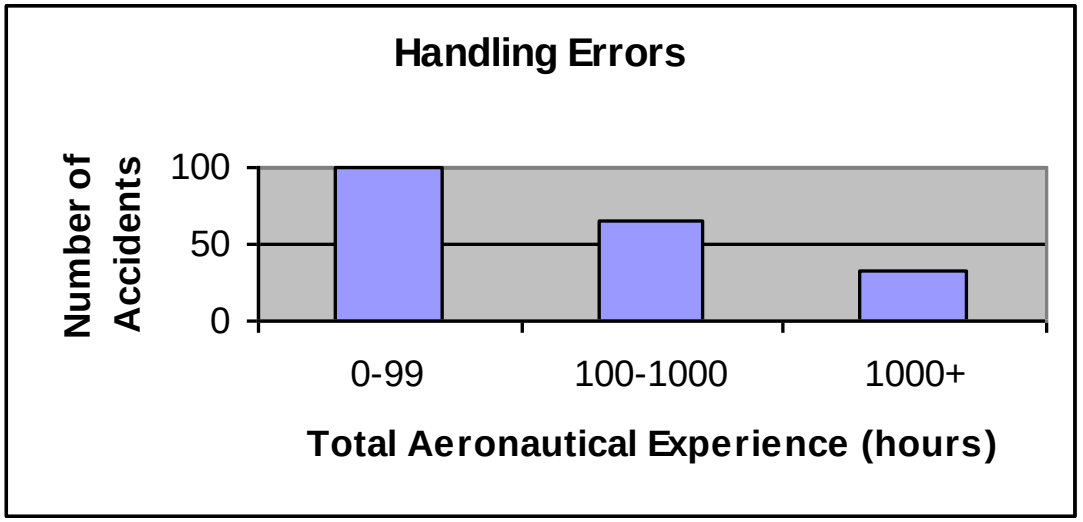
Projection

- Applying **knowledge** and **past experience** to **predict the likely outcome** of the current situation and **make a decision** about the most appropriate action to take

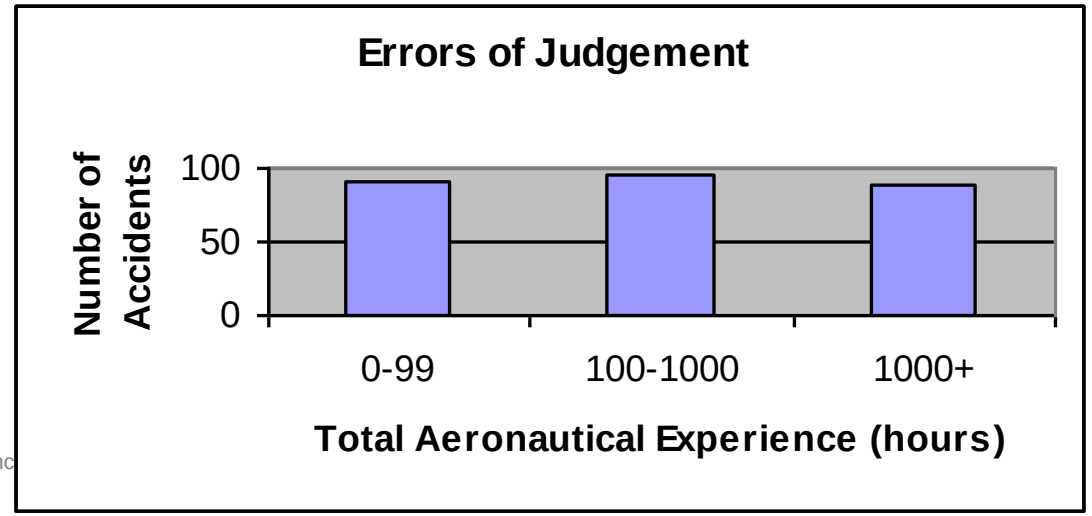
Experience vs. Errors

- **80%** of aircraft accidents are **human error**

- **Handling errors** decrease as pilot experience increases



- However, **procedural/ judgement errors** can be made by anybody!



Experience vs. Errors

UNDESIRED AIRCRAFT STATES

Undesired Aircraft States

"Any flight condition or attitude which was not intended by the operating crew Errors lead to Undesired Aircraft States."

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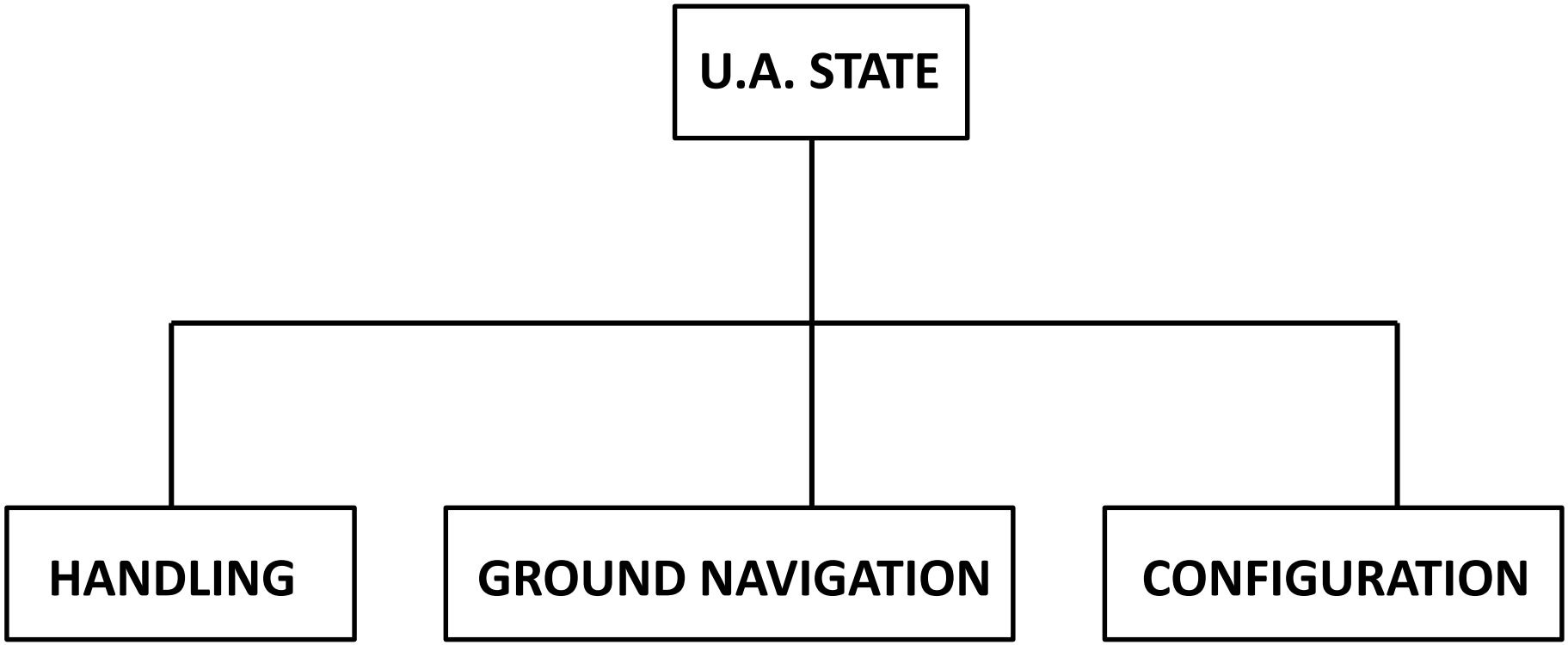
Undesired Aircraft States

"Any flight condition or attitude which was not intended by the operating crew Errors lead to Undesired Aircraft States."

- Aircraft Handling States
  - Control (in pitch, roll, yaw)
  - Flight path deviations (track, altitude, speed)
  - Weather or Airspace violation
  - Exceeding structural limitations
  - Poor technique
- Ground Navigation States
  - Using wrong taxiway or runway
  - Taxiing too fast
- Configuration States
  - Inappropriate flap selection
  - Incorrect autopilot mode
  - Incorrect GPS or Navaid Programming
  - Incorrect fuel/weight distribution

Undesired Aircraft States



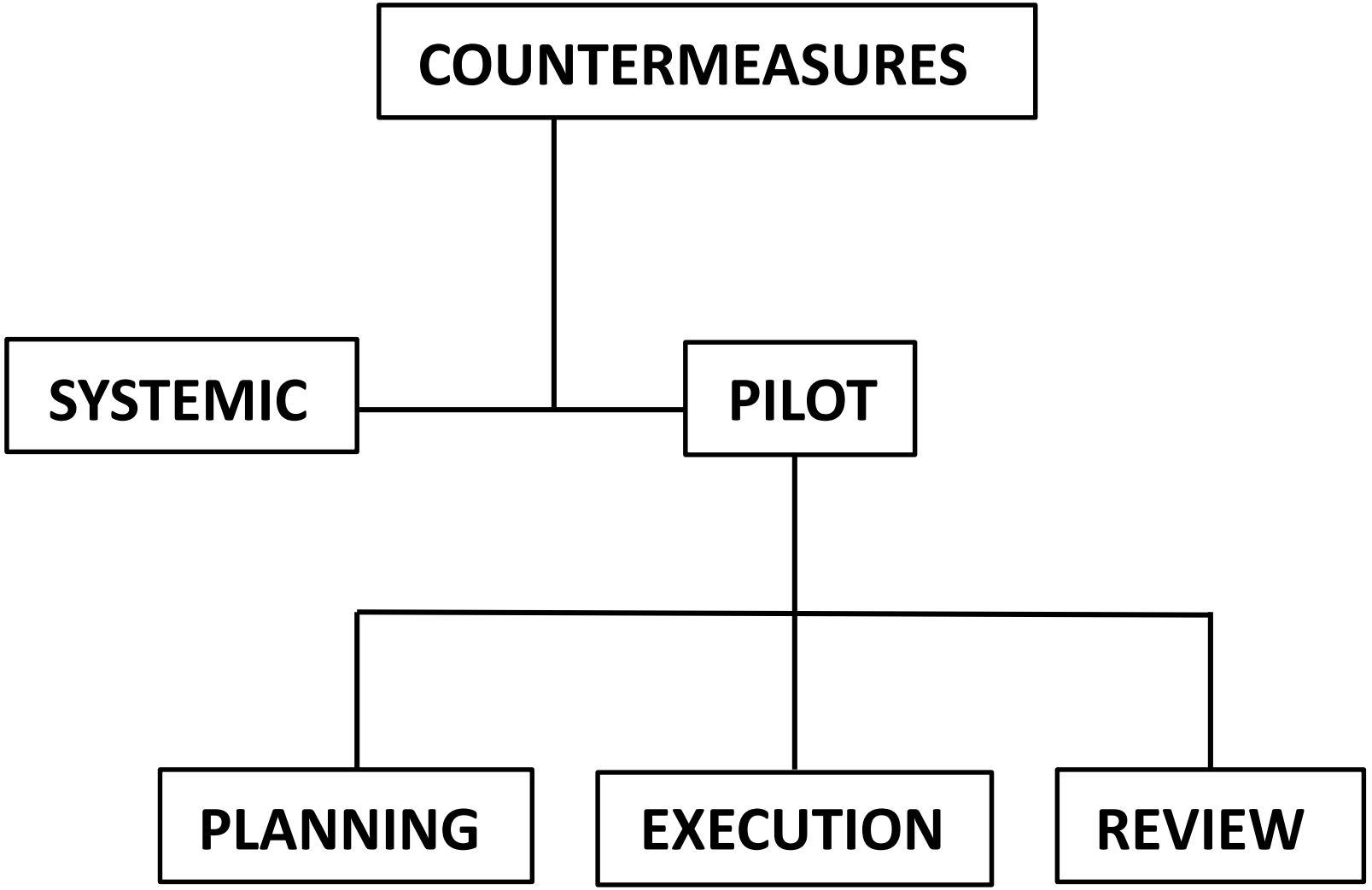
COUNTERMEASURES

Countermeasures

"The tools and techniques used to manage threats, errors and undesired aircraft states."

- Systemic Countermeasures (built into the system)
  - → Mechanical/Electronic
    - Stall warning/system failure warning
    - Air and ground proximity warning systems e.g. TCAS
  - → Other
    - SOPs, checklists
- Pilot Countermeasures
  - → Planning Countermeasures
    - Flight planning
    - Pre-flight brief
  - → Execution Countermeasures
    - **Monitoring** engine, flight and navigation instruments
  - → Review Countermeasures
    - **Modifying** plans as flight proceeds
    - Remaining alert and **assertive**

Countermeasures



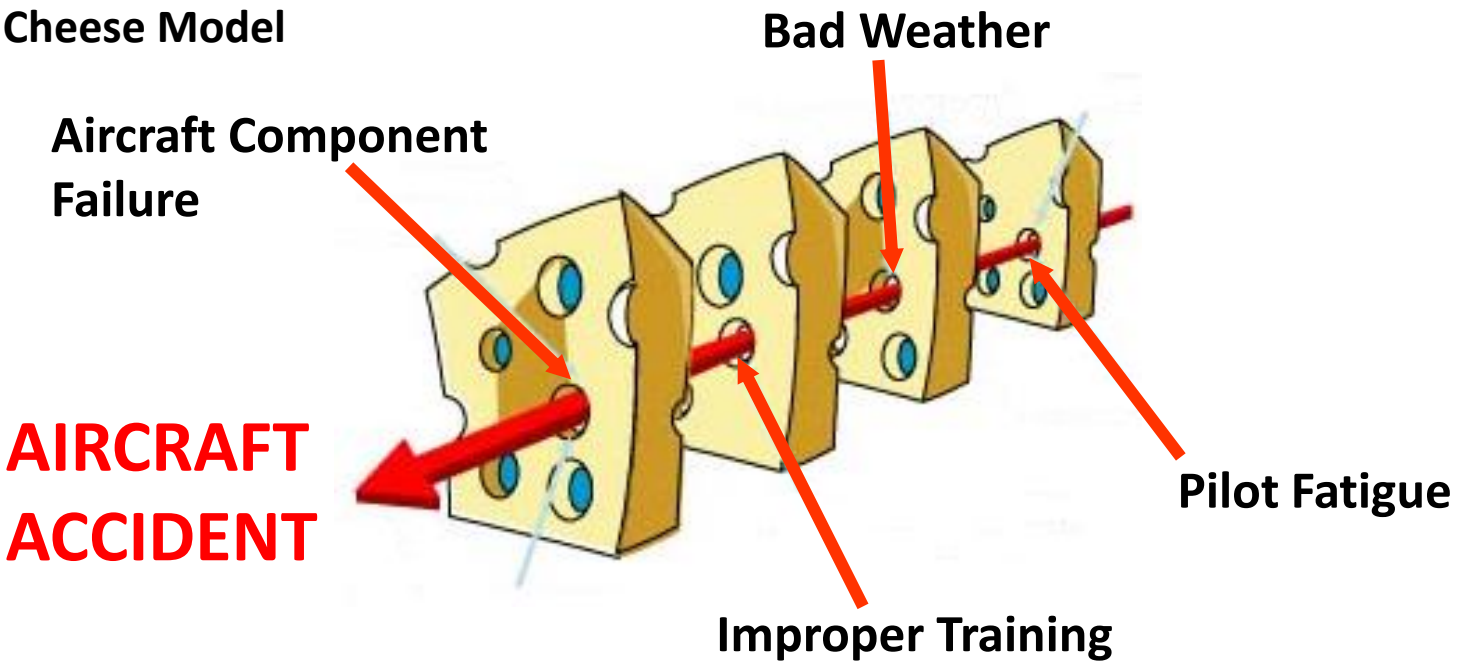
AIRCRAFT ACCIDENTS – CASE STUDIES

Aircraft Accidents – Case Studies

- Often, aircraft accidents are not caused by one single factor

- Rather, they are the result of a **series of circumstances** – when all the circumstances exist at the same time, an accident occurs

Swiss Cheese Model



- We will now look at some well-known aircraft accidents and examine the **threats** and **errors** that led to the **undesired aircraft states**

Case Study 1:
Northwest Airlink SAAB 340 – Memphis 2002

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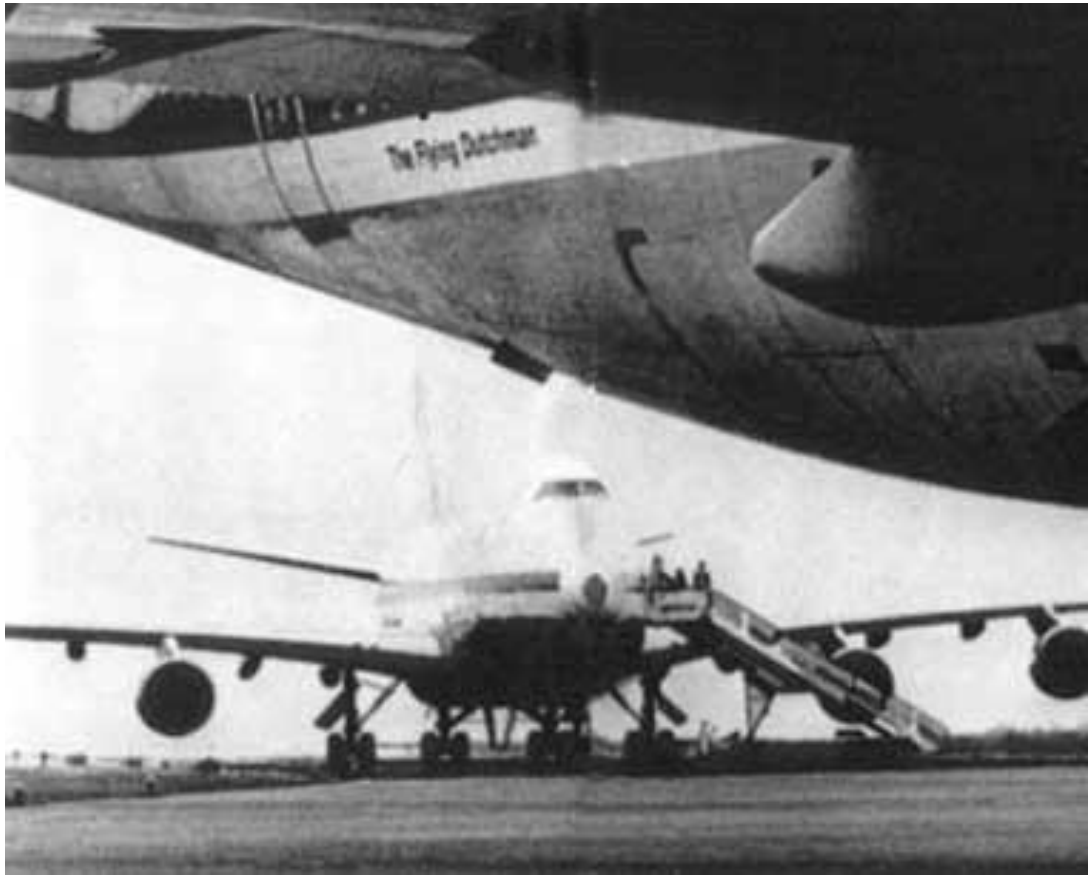
Case Study 2:
PanAm 747 & KLM 747 – Tenerife 1977



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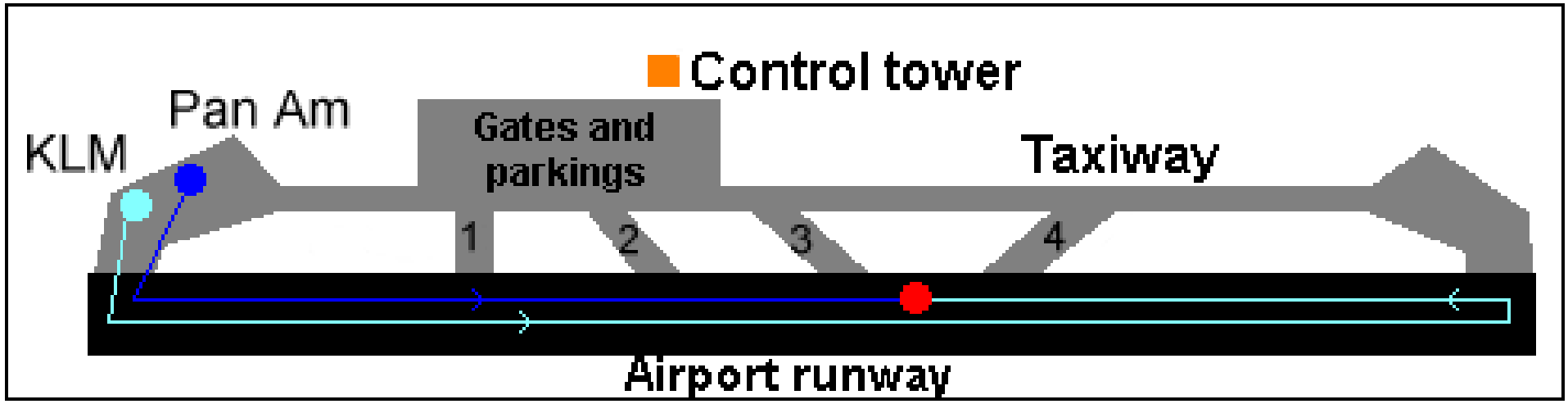

Case Study 2:
PanAm 747 & KLM 747 – Tenerife 1977

- Communications Transcript
- Animation Video
- Air Crash Investigations Video (brief)

Case Study 2:
PanAm 747 & KLM 747 – Tenerife 1977

Case Study 3:
United Airlines DC 8 – Portland, Oregon 1978

- Video: Focussed on Failure UA 173

- On approach into Portland, the aircraft suffered an apparent malfunction with the landing gear – the captain decided to hold at 5000ft and assess the problem
- For about 1 hour, the crew was so pre-occupied with the gear malfunction that they did not monitor the fuel levels
- Although the Flight Engineer once raised the fuel issue, the Captain was so pre-occupied with the gear problem that he took no notice
- The aircraft experienced a double engine failure on approach and crashed