EASA
European Union Aviation Safety Agency

Human Factors considerations

Syrus A. Lou

Austro Control

STC WORKSHOP

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Human Factors Considerations

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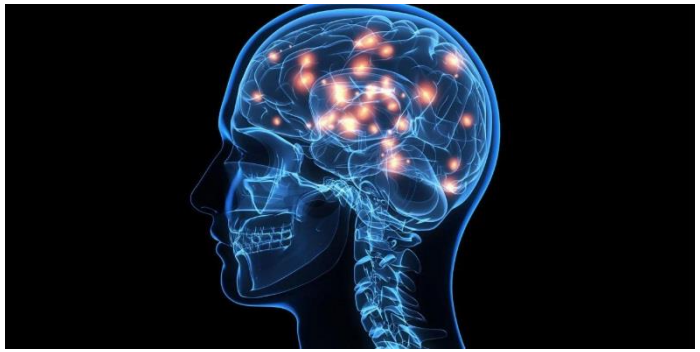
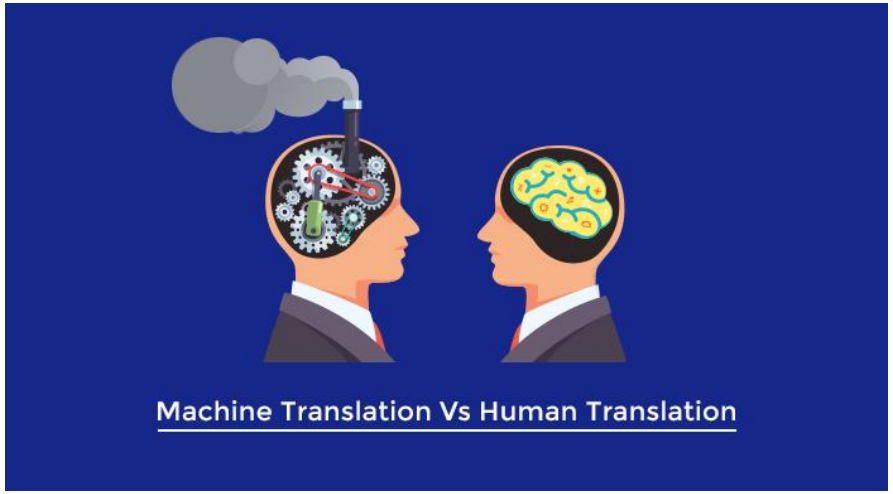


General Background on Human Factors (brief refresher)

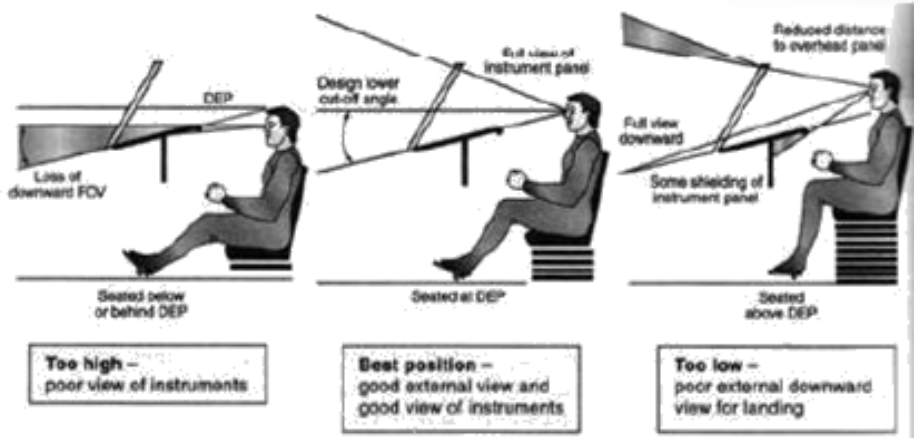
General Background

- We all know that the human being might be the weak element in the system
- Safety is paramount in aviation
- Numerous enhancement have been introduce to address errors caused by humans



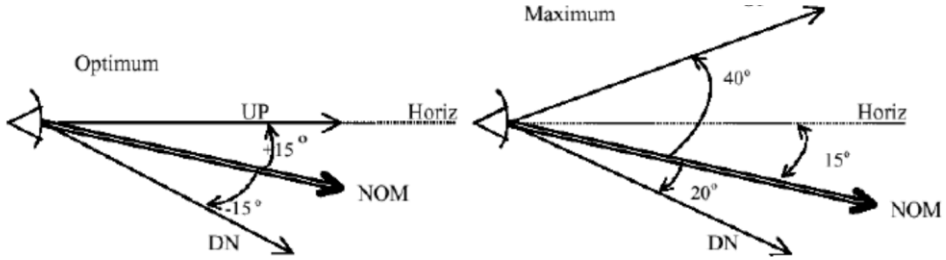
General Background

- What should be considered?
- The design of the change should basically address
  - Physical,
  - Cognitive, and
  - Organisational
- Ergonomics

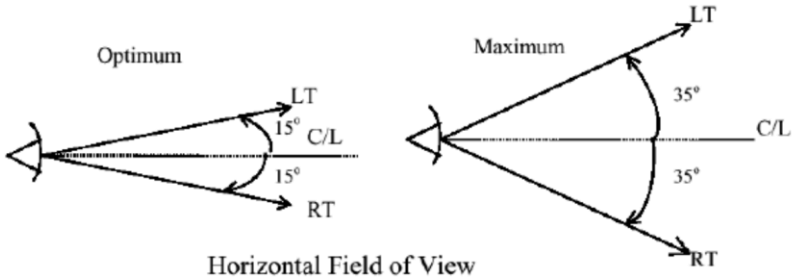


General Background

- **Physical Ergonomics** Concerns mainly the
  - human anatomy,
  - Physiological, and Biochemical Characteristics
- related to physical activites.
- Failures to consider the „work environment“ will cause **undue fatigue**, in some cases also **pain,** and results in
- Reduction of the crew **to cope** with adverse conditions



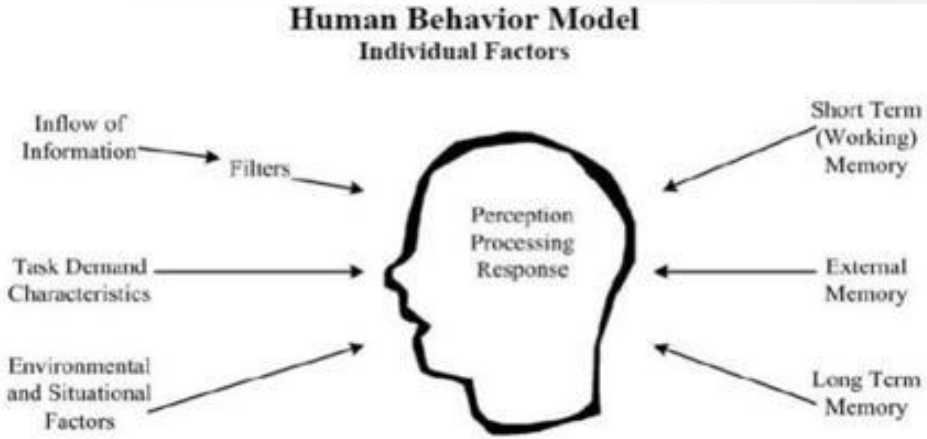
Vertical Field of View



Horizontal Field of View

General Background

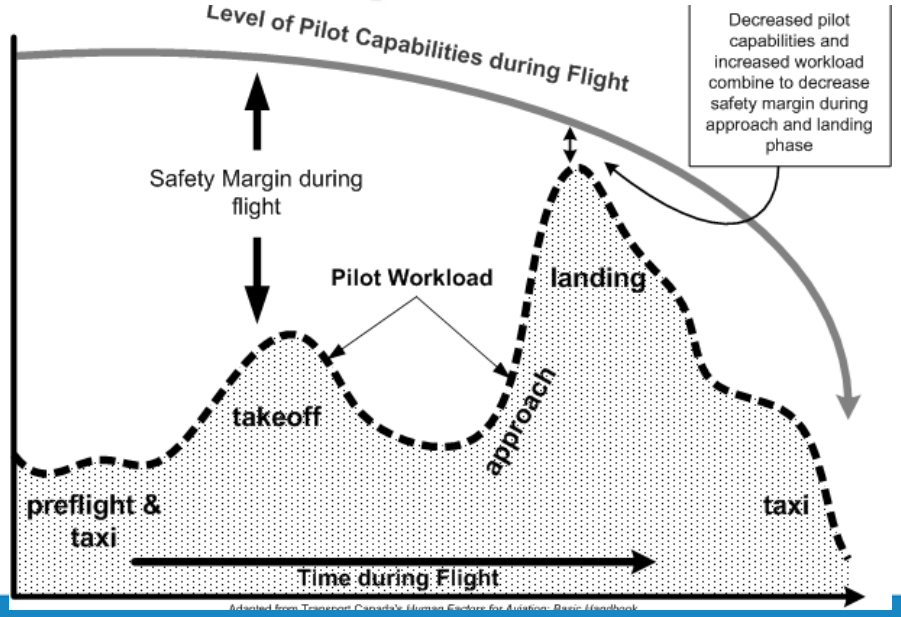
- **Cognitive Ergonomics** mental processes affecting humans and HMI, such as Perception, Memory, Reasoning, Response
- Relevant topics (related to HMI):
  - Mental workload,
  - Decision making,
  - Skilled performance,
  - Human reliability,
  - Work stress,
  - Training
  - …



General Background

- **Organisational Ergonomics** concerns optimization of organisational structures, policies and processes
- Relevant topics include
  - Communication
  - Crew resource Management (CRM)
  - Work design, -systems, -times,
  - Cooperative work
  - Quality management,

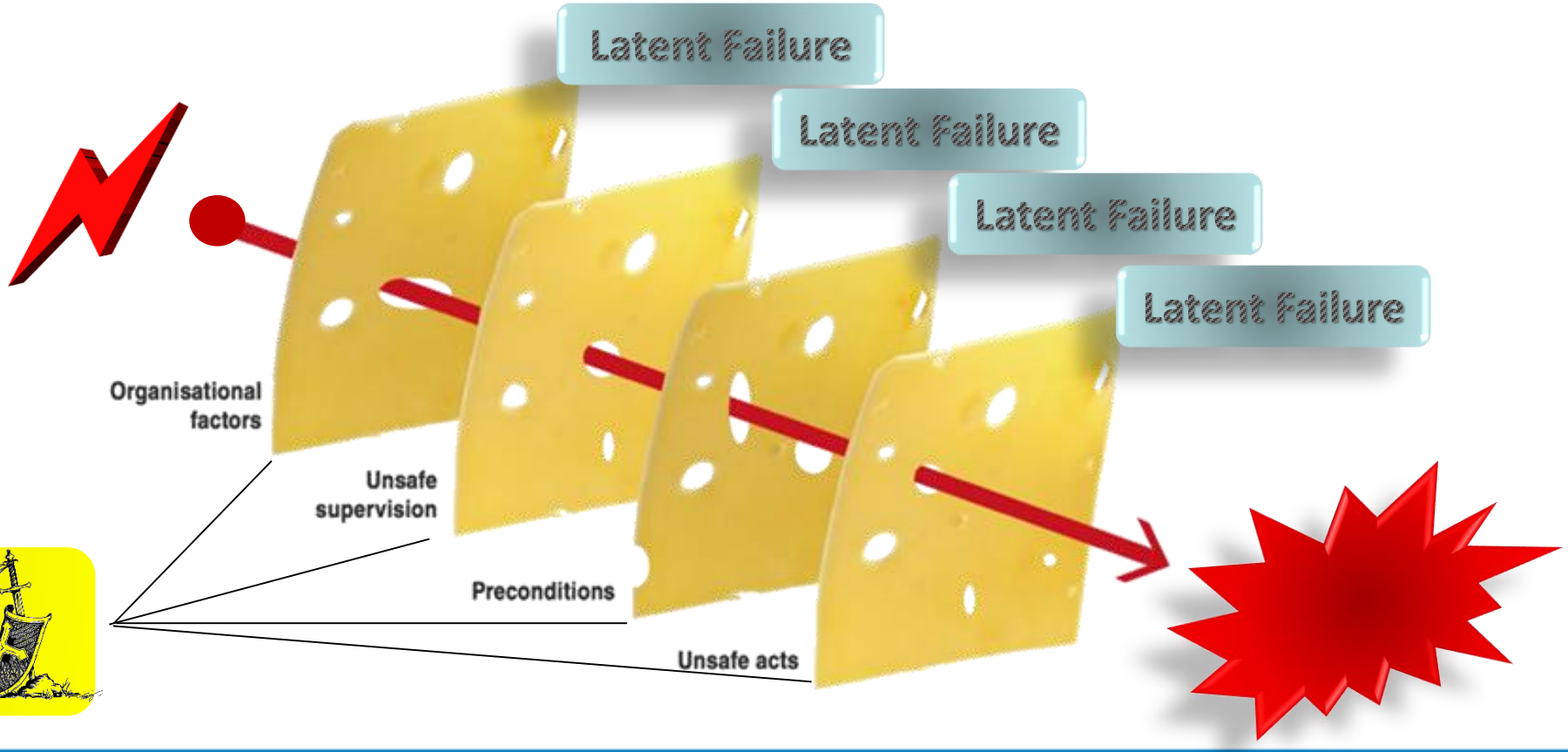
  …



General Background

The „swiss cheese“ model of human error causation (adapted from Reason, 1990)

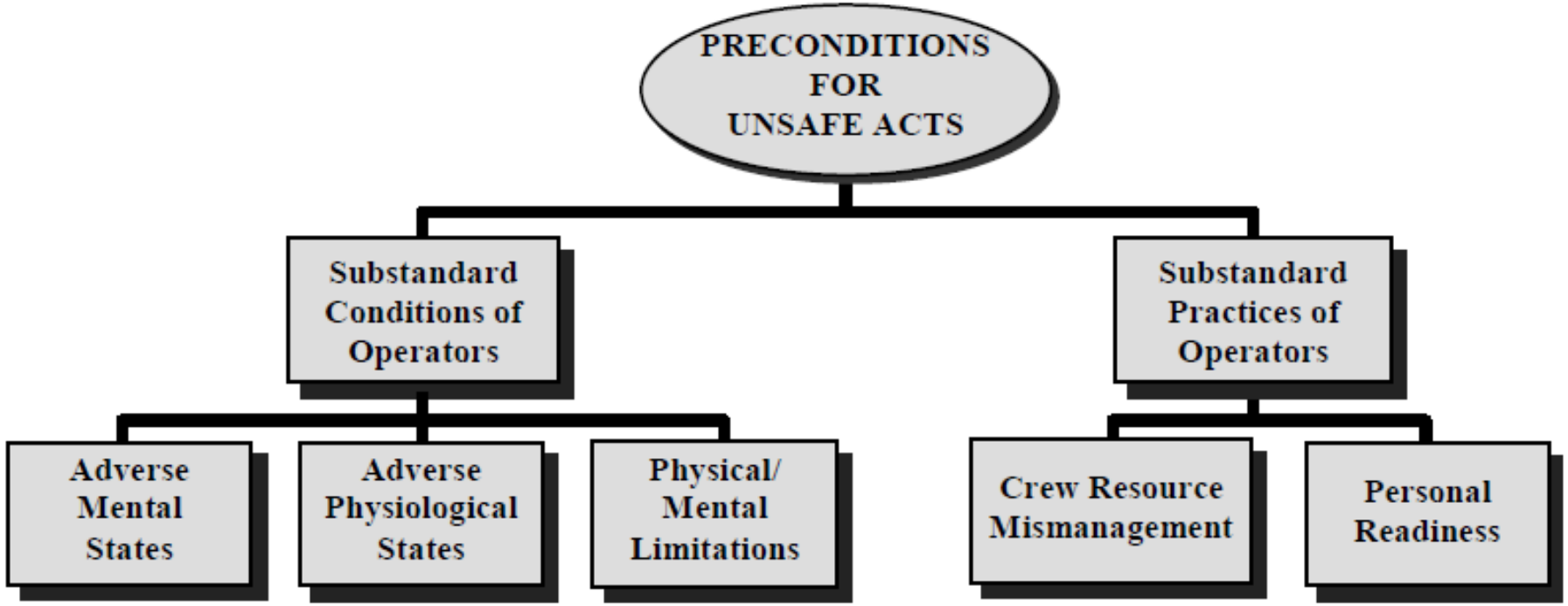
i.e.: Used in CRM Training



- Failed or absent defense

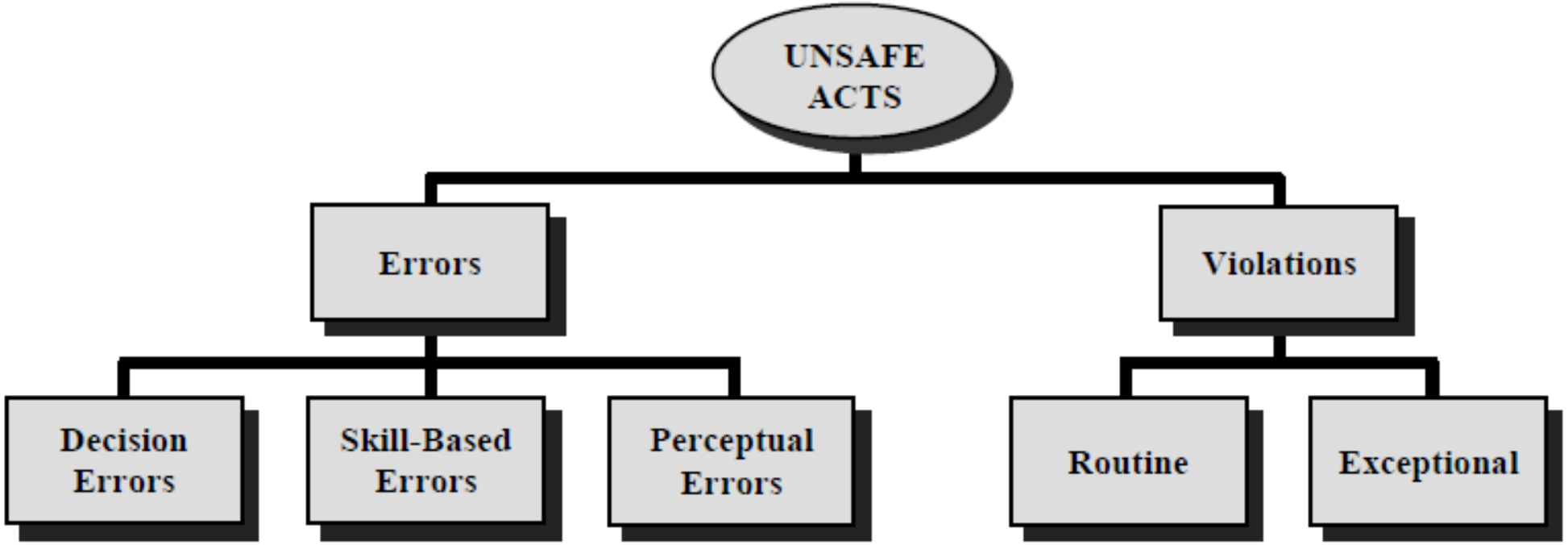
General Background

- Knowing the different barriers, following questions appear?
  - **<u>Which</u>** of the four defense lines does design directly affect?



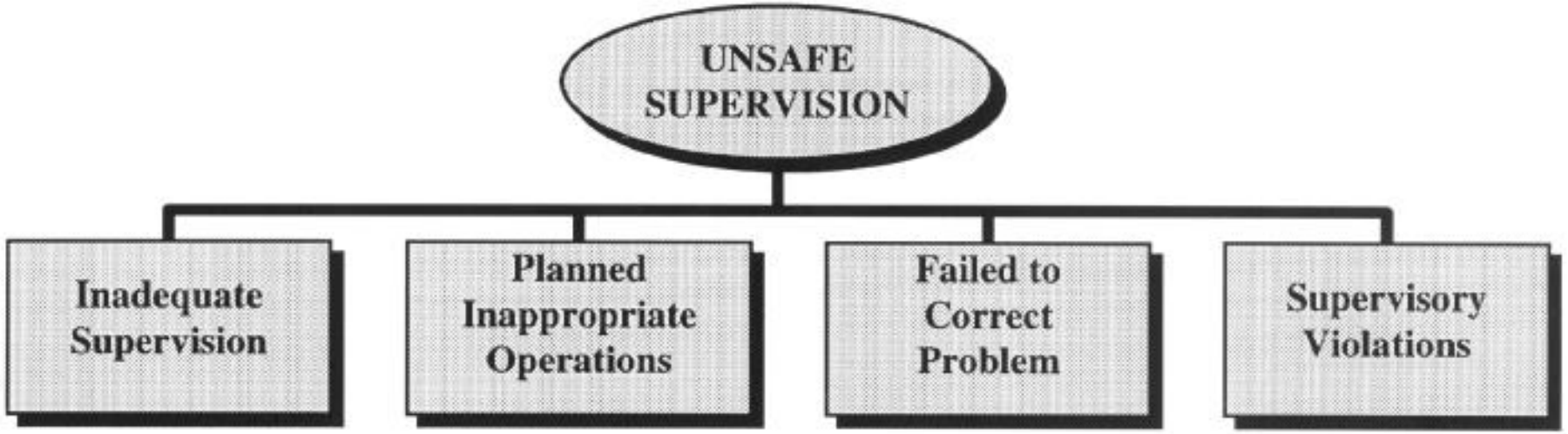
General Background

- Knowing the different barriers, following questions appear?
  - Does the design have an **impact** on other defense lines?



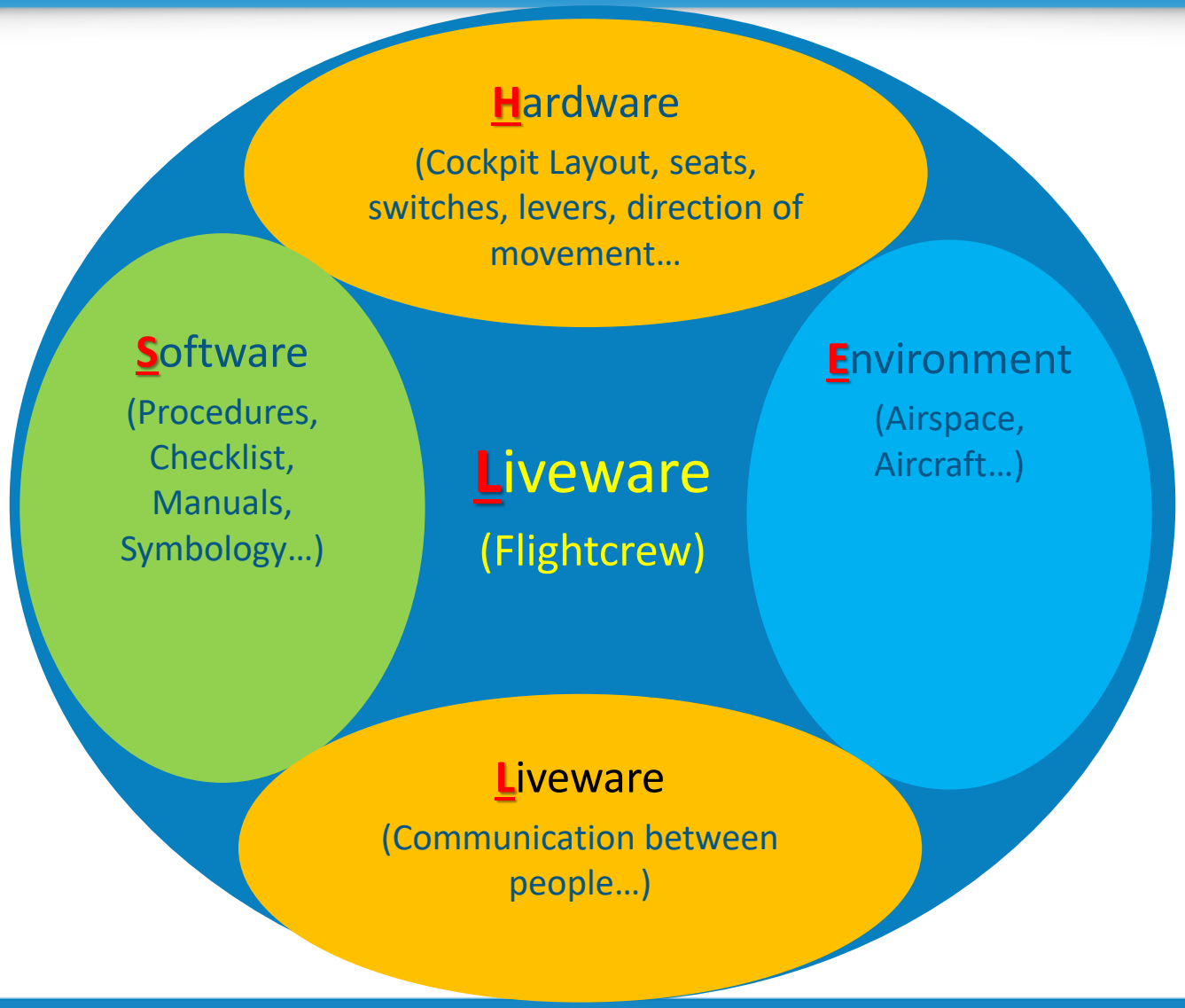
General Background

- Knowing the different barriers, following questions appear?
  - How could we **enhance the design** to enable the responsible persons to be more efficient?
- With the overall goal to enhance safety and reduce problems araising from human factors



General Background

SHELL-Model

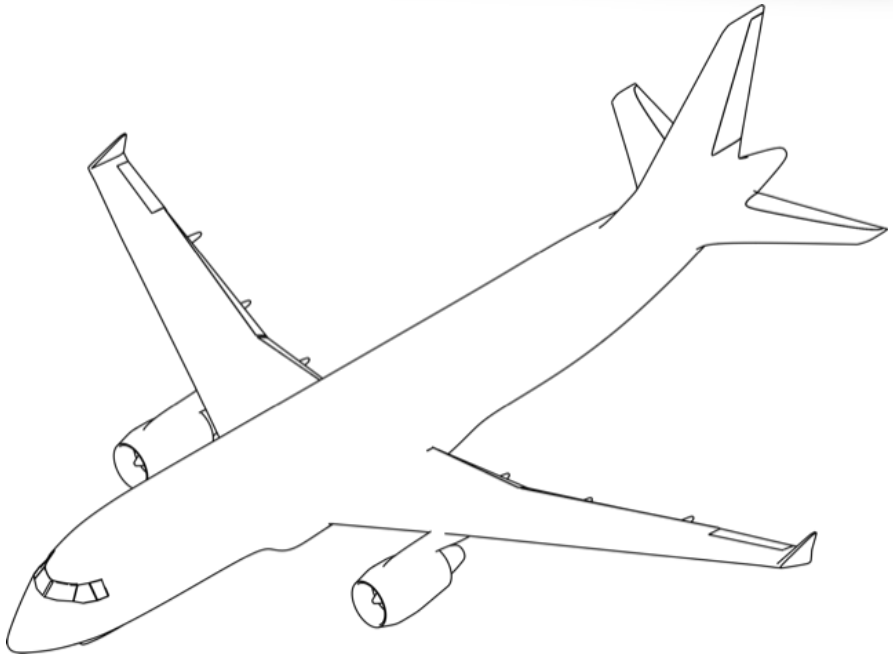


Areas to consider

Areas to Consider

- In all our efforts to introduce improvements and enhance system functionality,

- We should never loose the focus on the MAIN DUTIES of the persons involved in these improvements



Areas to consider

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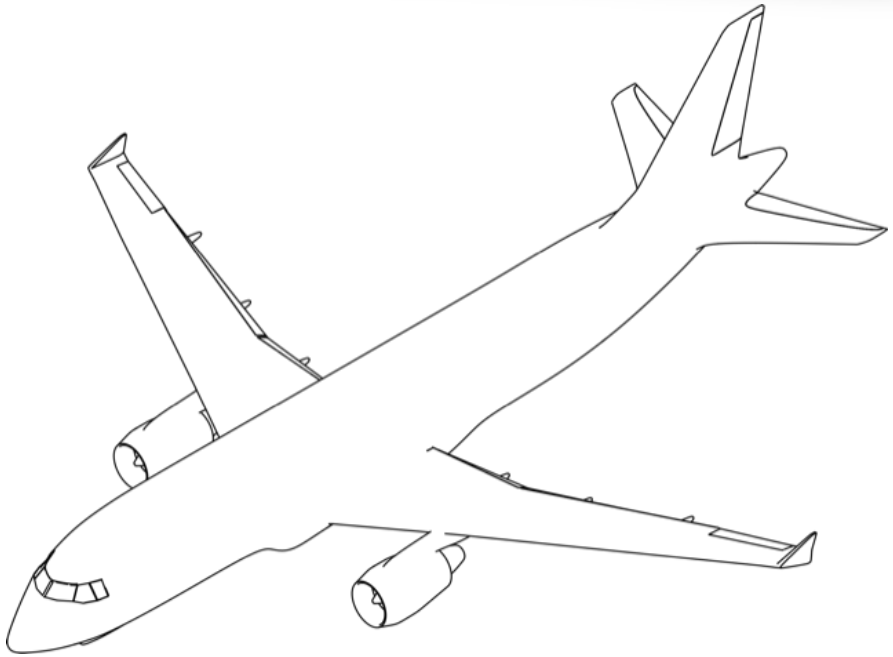
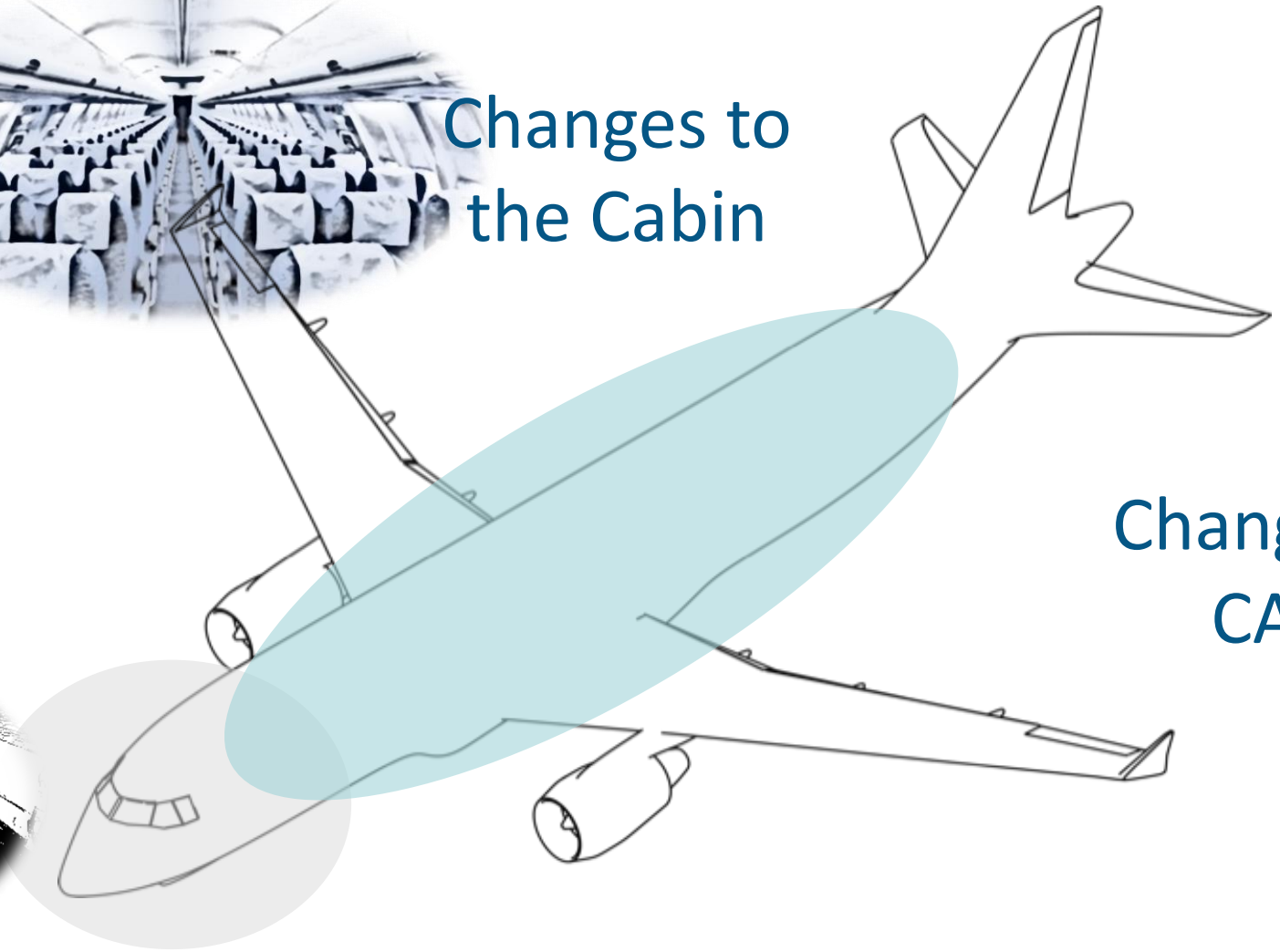
Kind and size does not matter



Areas to Consider

Changes to the Cabin



Changes in the Cockpit

Changes to CAW

Areas to Consider

Question: What is the main duty of the flight crew?

A: Announce weather information at the destination airport and look cool

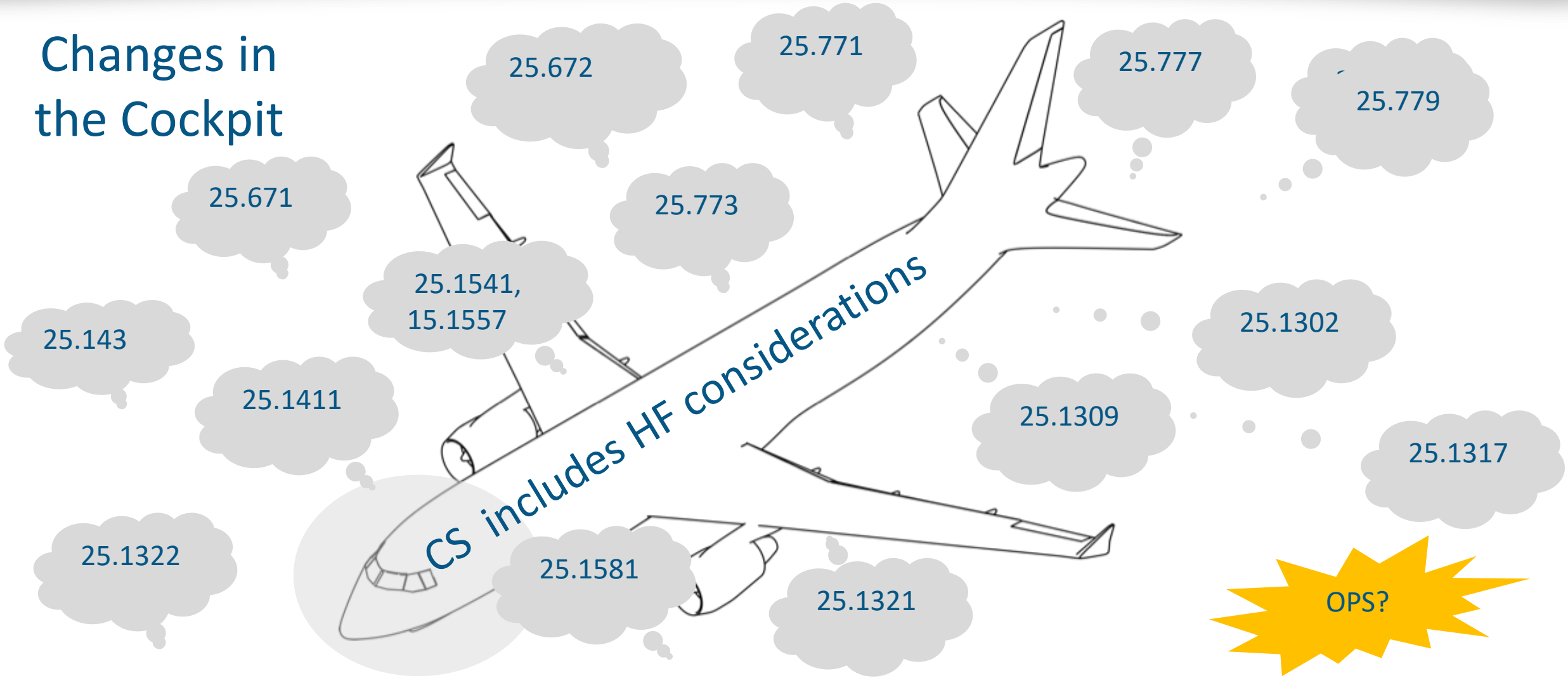
B: Pushing buttons to enter the third level of a submenue of a system to get essential information

C: Fly the aircraft

Changes in the Cockpit

Areas to Consider

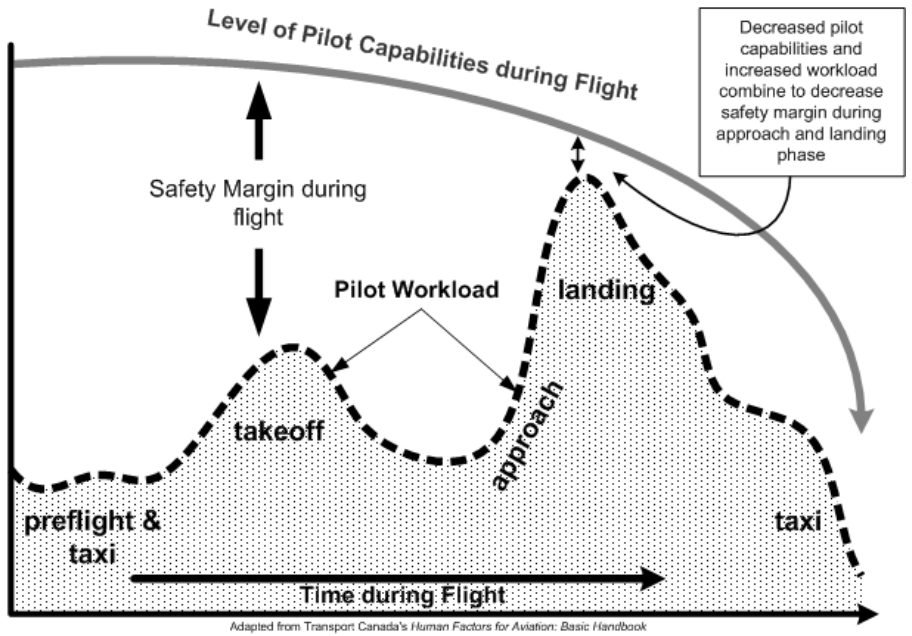
Changes in the Cockpit



Areas to Consider

Assumption:

- Aircraft is in approach
- Radio Altimeter MISCOMP
- Several systems go off:
  - ACAS II (Flag)
  - EGPWS (Flag)
  - Autopilot (approach)
- Resulting in red or amber warnings on the EICAS



Areas to Consider

- CREW distracted and starts to identify warnings and cautions
- At the same time, Autothrottle command „Idle“ due to armed approach mode

- The throttles move backwards
- The crew might be distracted from the throttle movement due to numerous red warnings in the primary field of view

- And might not react in time to increase thrust again

- Probably resulting in a STALL situation near ground

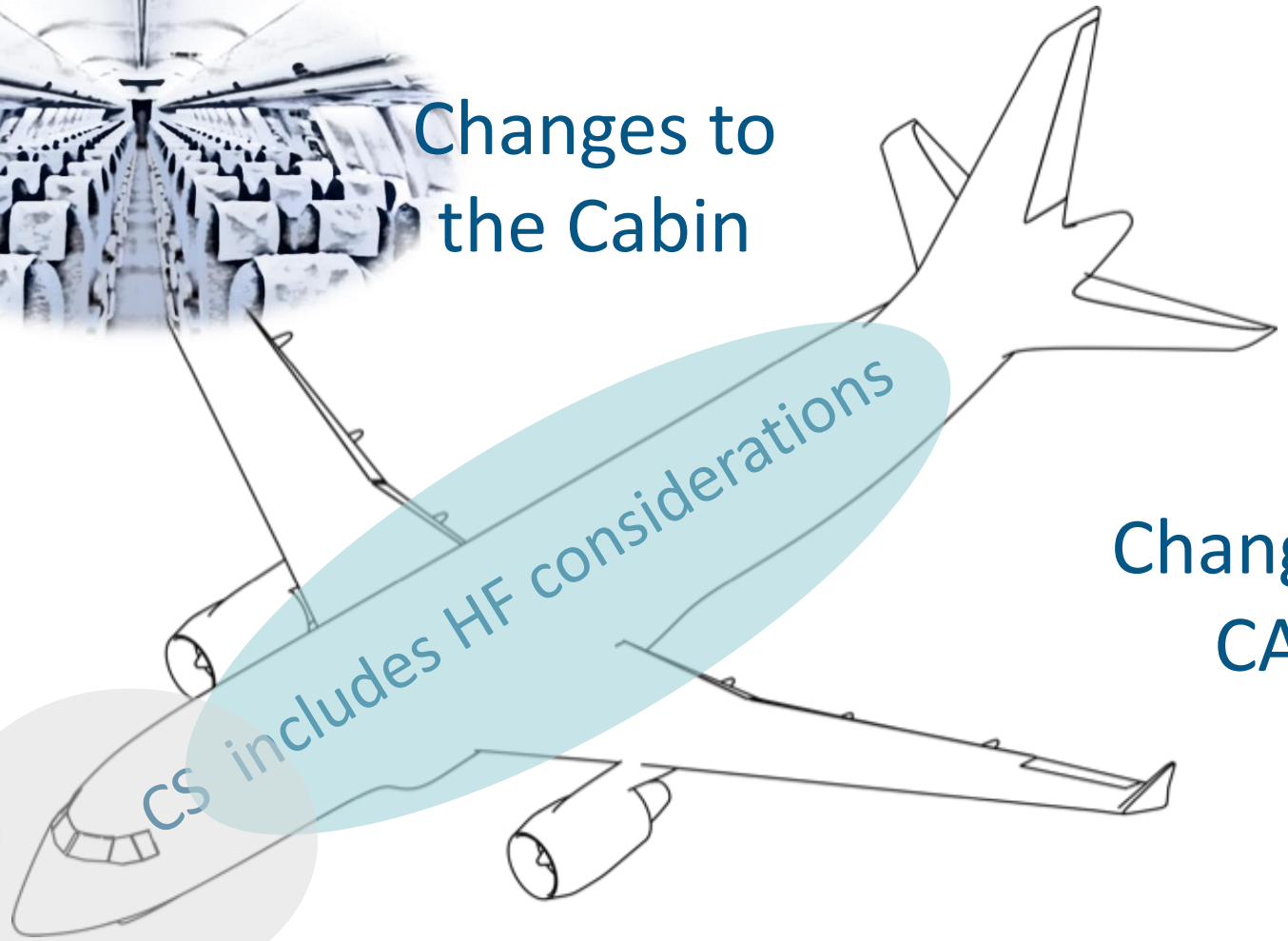
Areas to Consider

- …And you were the one securing the deal for modification of the existing Radio Altimeters and TCAS computers with new ones…
- O.K. … this is **catastrophising** – but is such a scenario impossible?
- Is it not worth thinking of the possiblity that the flight crew might be unintentionally directed to make the wrong decision?

Areas to Consider

Changes to the Cabin

Changes in the Cockpit



CS includes HF considerations

Changes to CAW

Areas to Consider

Changes to the Cabin

Question: What is the main duty of the cabin crew?

A: Serve tea, coffee and meals while being unnaturally polite and look very pretty

B: Operting highly complex and complicated passenger entertainment systems

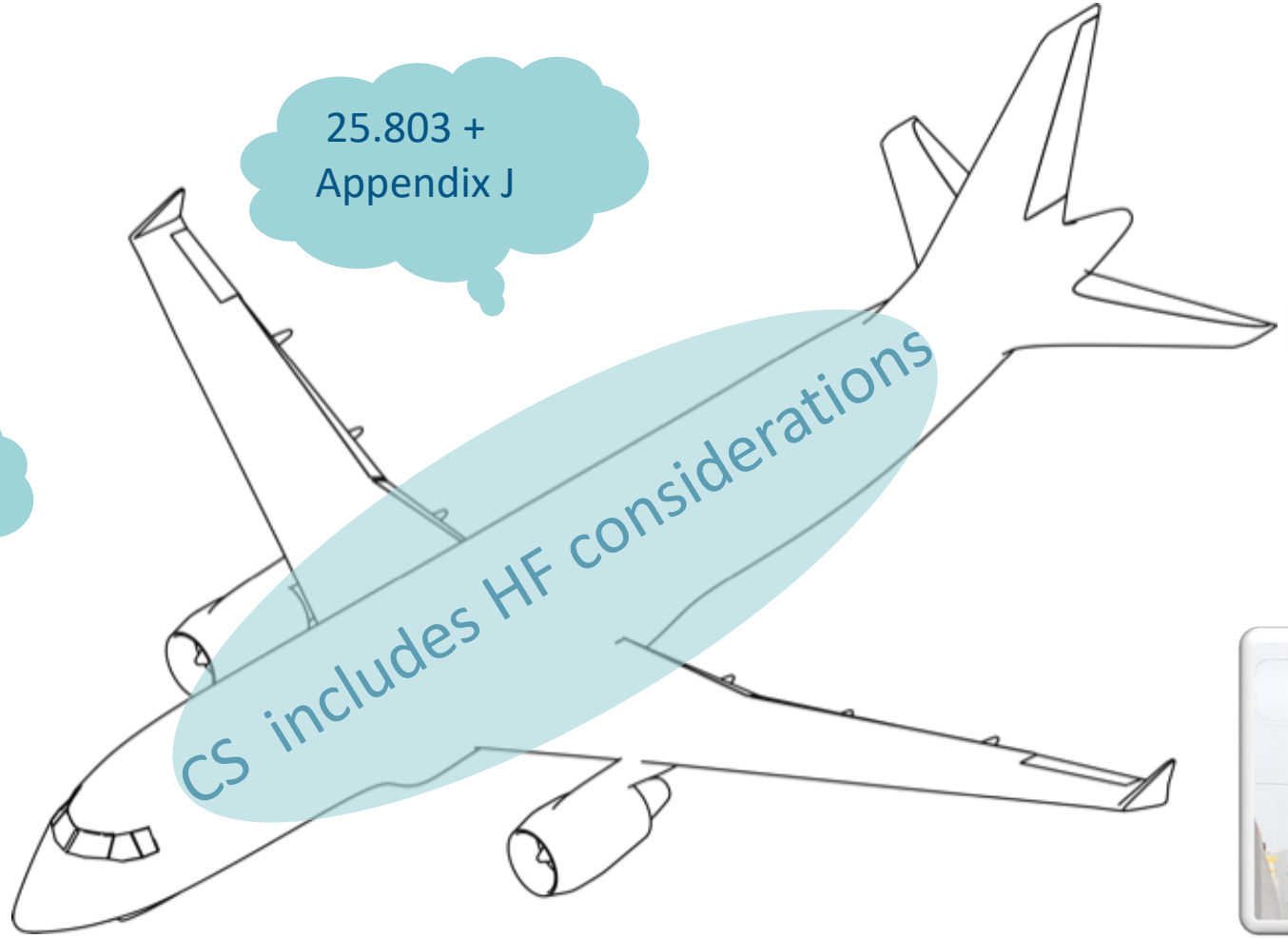
C: Ensure safety in cabin and assisting the FC in abnormal or emergency sitations (fire fighting, unruly passengers, emergency landings…)

Areas to Consider

Changes to the Cabin

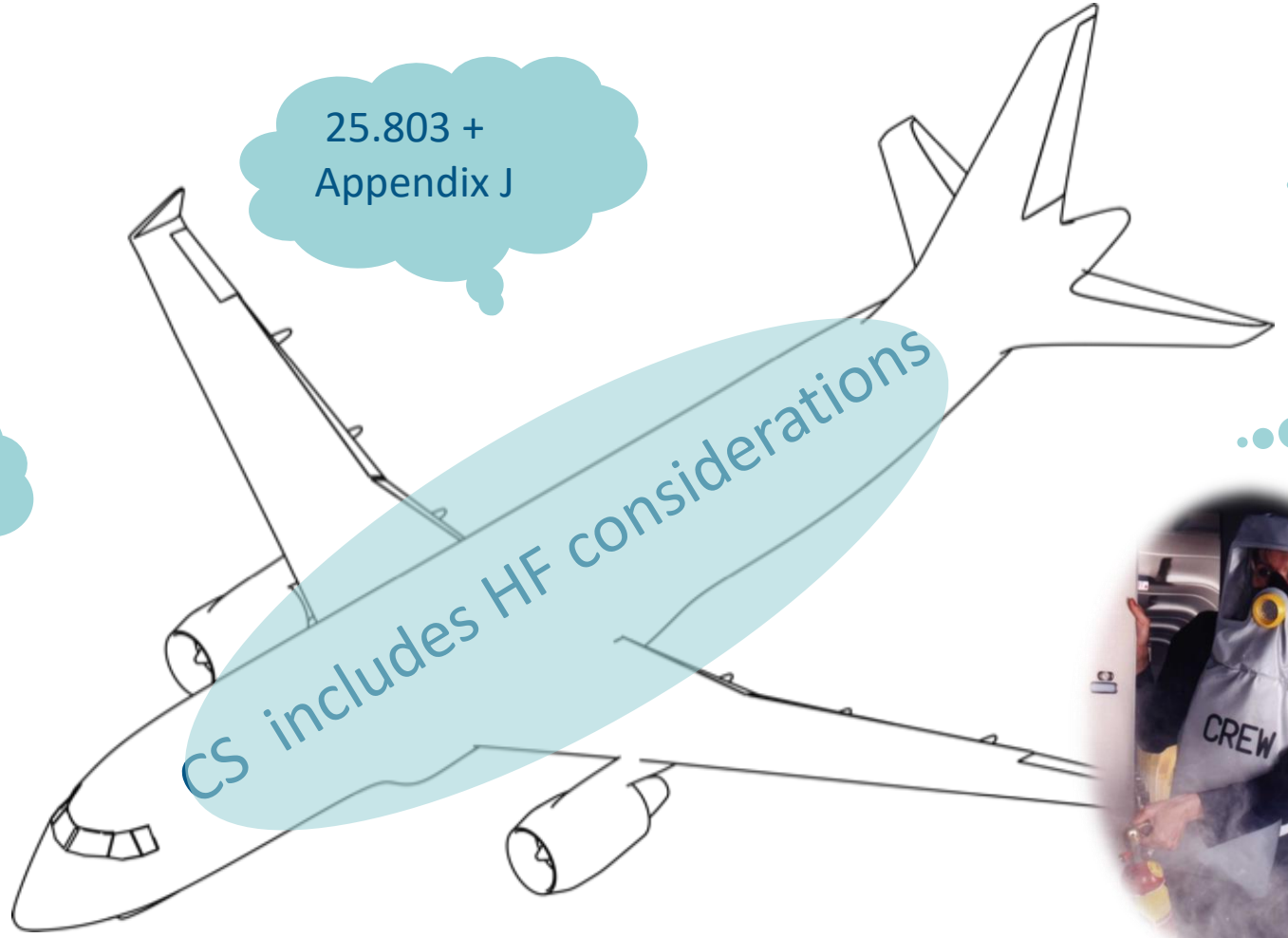
25.803 + Appendix J

25.783



Areas to Consider

Changes to the Cabin



25.803 + Appendix J

25.851

25.783

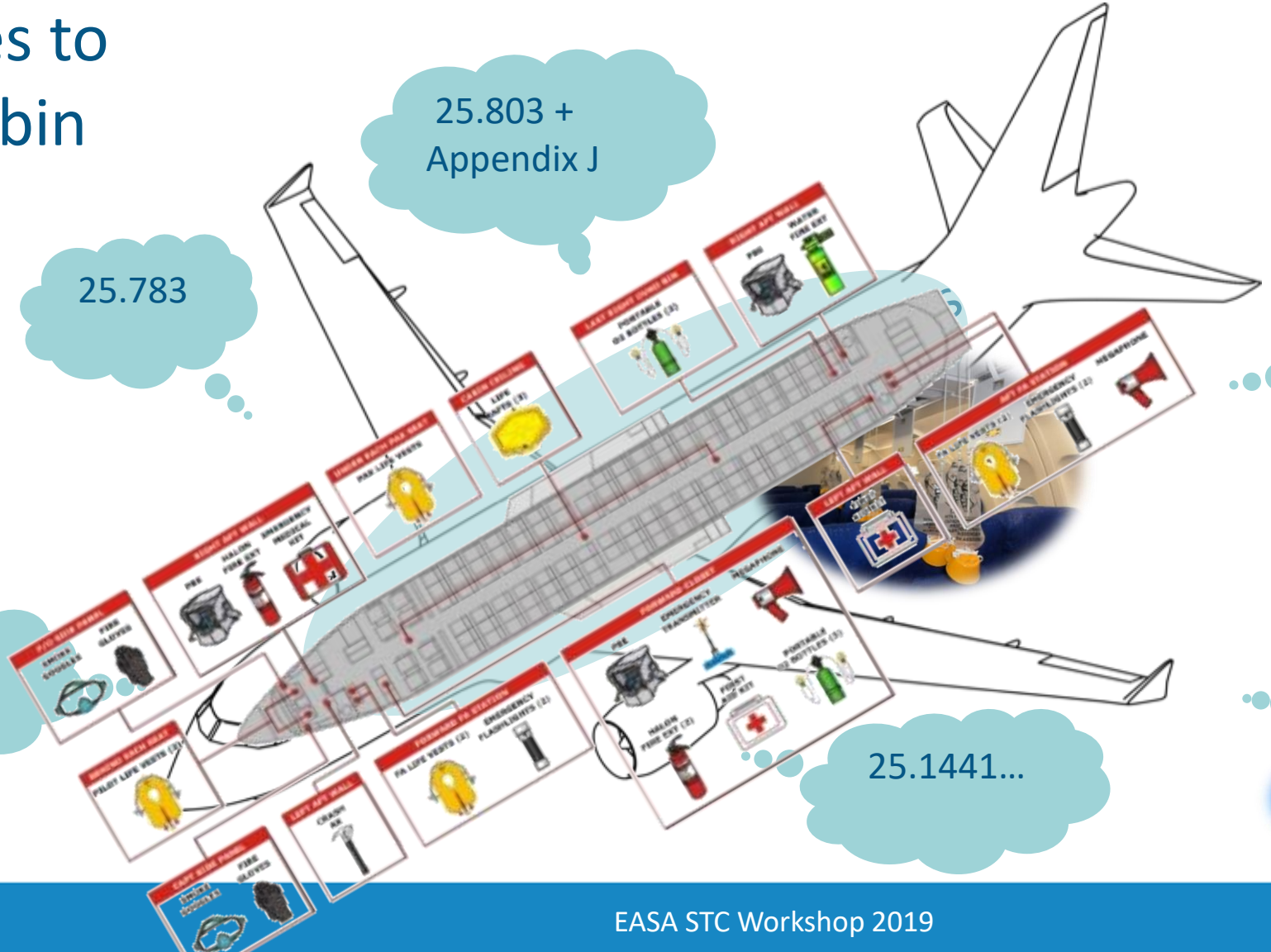
CS includes HF considerations

25.1411

25.1423

Areas to Consider

Changes to the Cabin



25.803 + Appendix J

25.851

25.783

25.1411

25.1423

25.1561

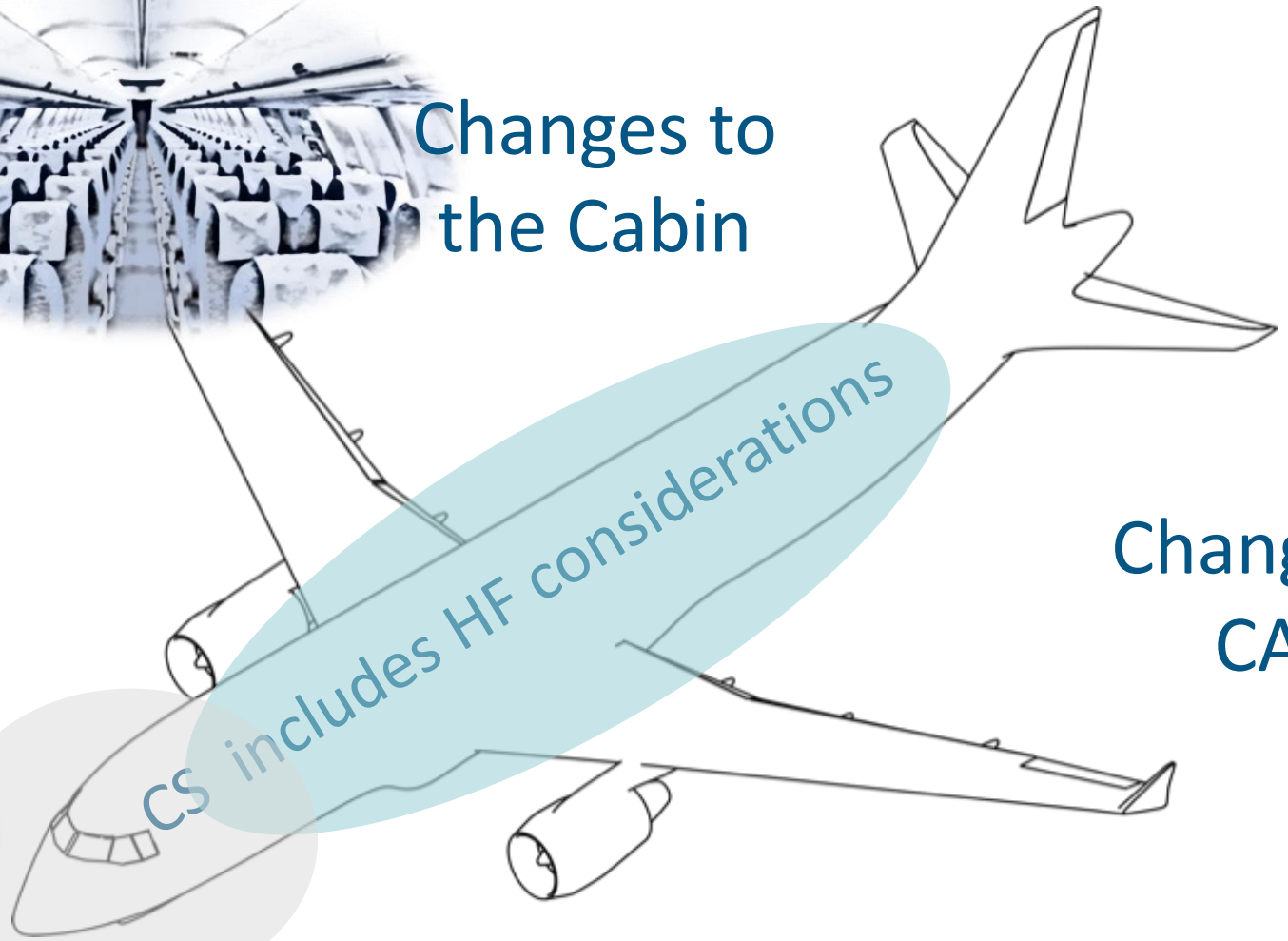
25.1439

25.1441…

Areas to Consider

Changes to the Cabin

Changes in the Cockpit



CS includes HF considerations

Changes to CAW

Areas to Consider

Changes to CAW

Question: What is the main duty of the mainenance crew?

A: Clean the aircraft and put the thumb up when the engine is started

B: Spending uncountable shifts to understand what is meant in the instructions written explicetly for him/her

C: Keep the aircraft in an airworthy, good and safe condition for flight

Areas to Consider

Changes to CAW

25.1529 + Appendix H

25.1301

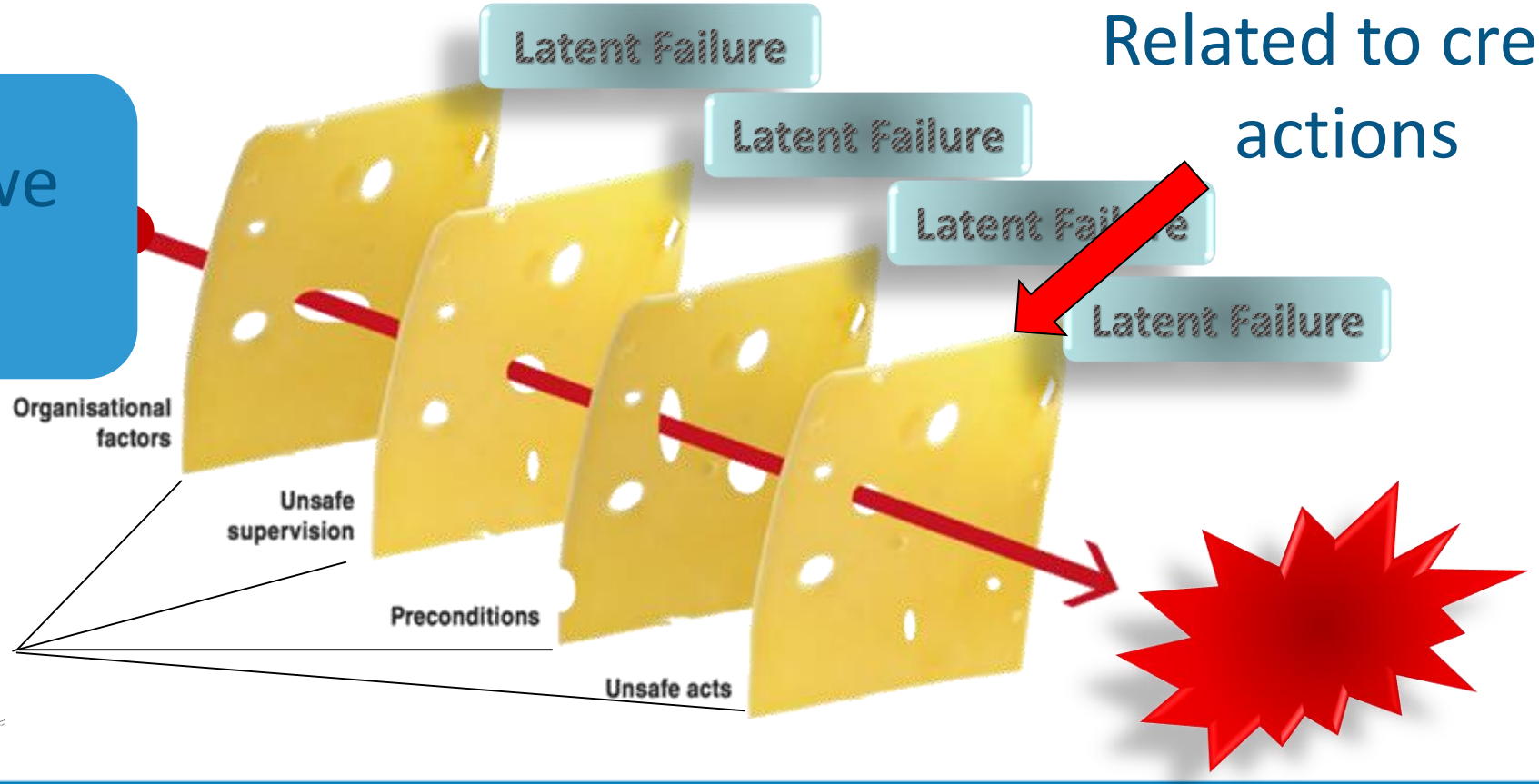
CS includes HF considerations

Awareness and good practice

Awareness and good practice

Which defense line are we traditionally mainly focusing at Initial Certification?

But is this the best we can?



Related to crew actions

- Failed or absent defense

Awareness and good practice

- I receive regularly the feedback from my OPS colleagues that
  - Aircraft modified with STCs do often not comply with OPS rules
  - Associated manuals (mainly AFM) are missleading or simply wrong
  - Procedures are not clearly identified

- Resulting in (heavy) delays until the aircraft could be operated…
- … And additional pressure on individuals…

Awareness and good practice

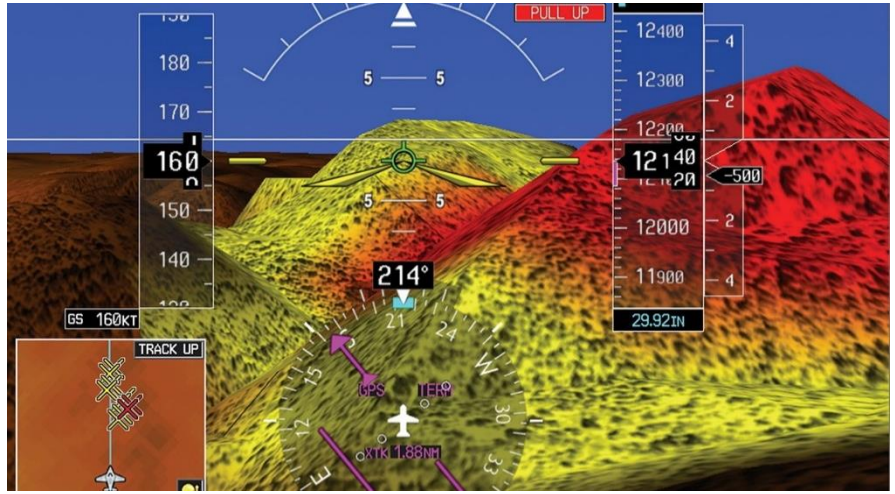
- ORO.FC.115 defines CRM
- Crew is regularly trained on CRM based on aircraft design
- Is it worth it to review the overall workload of the crew – even a „nice to have“ equipment is added?

Awareness and good practice

- Examples:

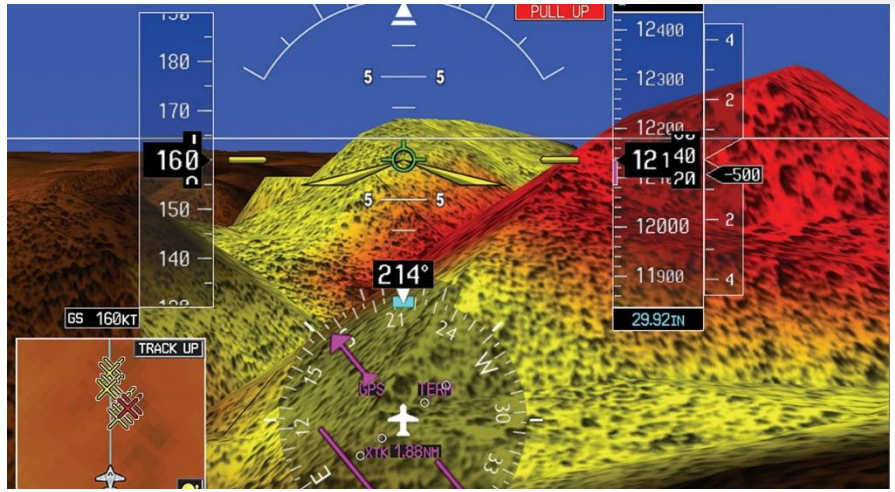
- „For situational awareness“
  - On one hand, such functions might enhance safety

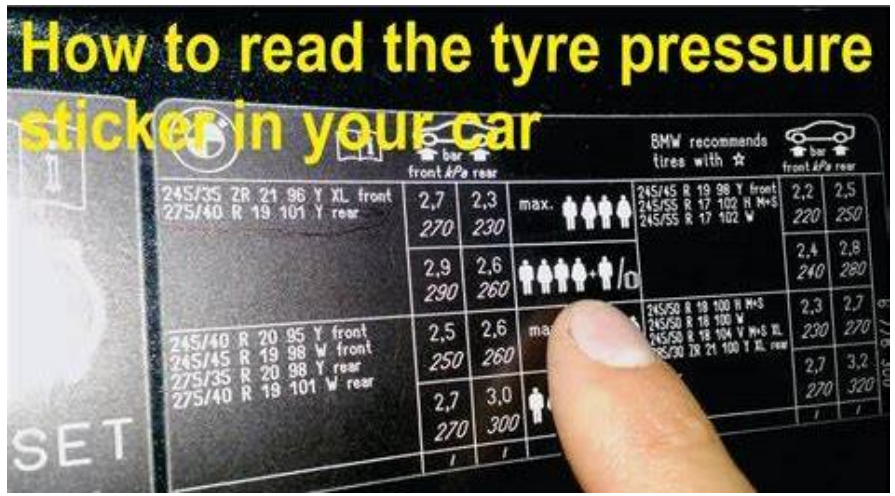
  - BUT, if not assessed completely, they might be compelling and result in Violation



Awareness and good practice

- Someone might say: The pilot has to stick to the limitations written in the handbook…
- Who of you performs a DAILY check of the tire pressure of your car? Weekly? Monthly? Whenever the tires are changed? During Maintenance… you assume?
- Why? Never had a problem with it





Awareness and good practice

- Examples:
- „No Hazard – No Credit“ basis
  - 1st: Same as „for situational awareness“
  - 2nd: Increase in workload – has the deactivation of such system been assessed from a HF point of view?
- What if more than one „No Hazard – No Credit“ systems are installed?
- How to distinguish in a stress situation from what is trustworthy and what is „no-credit“?

- From a HF Point of view:

- Relaxing in low work situation is very supportive to concentrate during high workload situations
- How should the flight crew relax for some minutes, when no headrest is installed?

Awareness and good practice

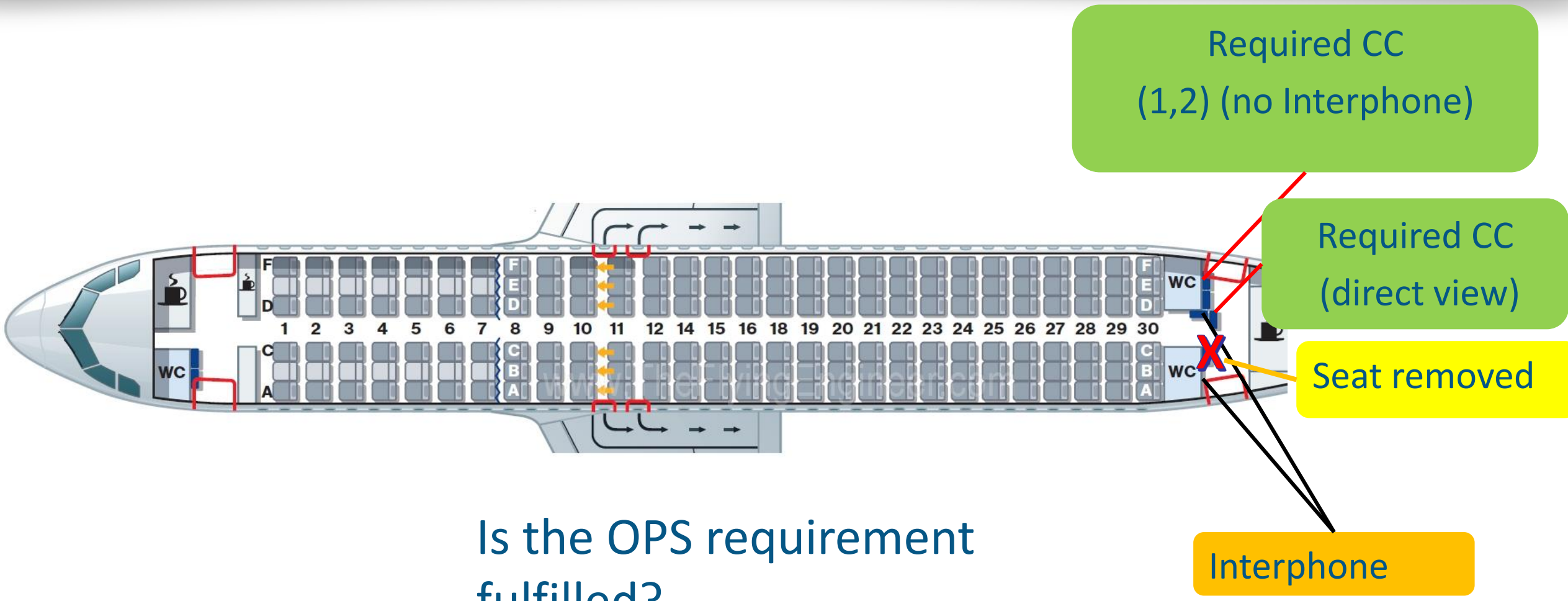
25.1423

- (g) For each **required floor-level passenger emergency** exit which has an adjacent cabin **crew member seat**, have **a microphone** which is **readily accessible** to the ***seated*** cabin crew member**, except** that one microphone may serve more than one exit, provided the proximity of the exits **allows unassisted verbal communications** between seated cabin crew members.

CAT.IDA.A.175 (AMC)

- in the case of aeroplanes where at least one cabin crew member is required, be readily accessible for use at **required cabin crew member stations** close to each **separate or pair of** floor level emergency exits;

Awareness and good practice



Is the OPS requirement fulfilled?

Awareness and good practice

- Example:
- AMAC Aerospace **reviewed** the **existing design** during installation of own STC
- AMAC figured out that there is a **slight inconsitency** of switch location design in the cockpit
- **Corrected** this arrangement **because of HF** considerations (*although not responsible for the initial design*)

- This is seen as good practice!

Awareness and good practice

- Example – Low occupancy aircraft:
- Aircraft below 19 Pax might not require a CC prescribed by the operating rules
- Workload assessments are required to check if the tasks normally done by the CC could be done by someone else
- On larger aircraft, a CC might be required to demonstrate compliance to required procedures (Fire fighting, Emergency preparation etc.)

Awareness and good practice

- Example – Small Equipment:
- Small aircraft tend to have the **same information** displayed as large aircraft
- But with **less space**, resulting
- In **smaller letters** and symbols
- Hardly readible during normal condition
- Is it really a good choice to install such equipment?

Conclusion

Conclusion (related to Human Factors!)

- Including HF considerations in design is **vital to sa**fety enhancements
- A **bad design** will not be better with pre-defined procedures
- ***Don't elaborate on complex solutions for simple problems***
- Use **new AMC** material to better account for HF issues (…CS-ACNS, 25.1322…)
- Follow the KISS principle
- REVIEW also the **requirements your CUSTOMER** has to follow (i.e.: OPS rules)

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Thank you for your attention!

Questions?

Your safety is our mission.

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