

Learning From All Operations

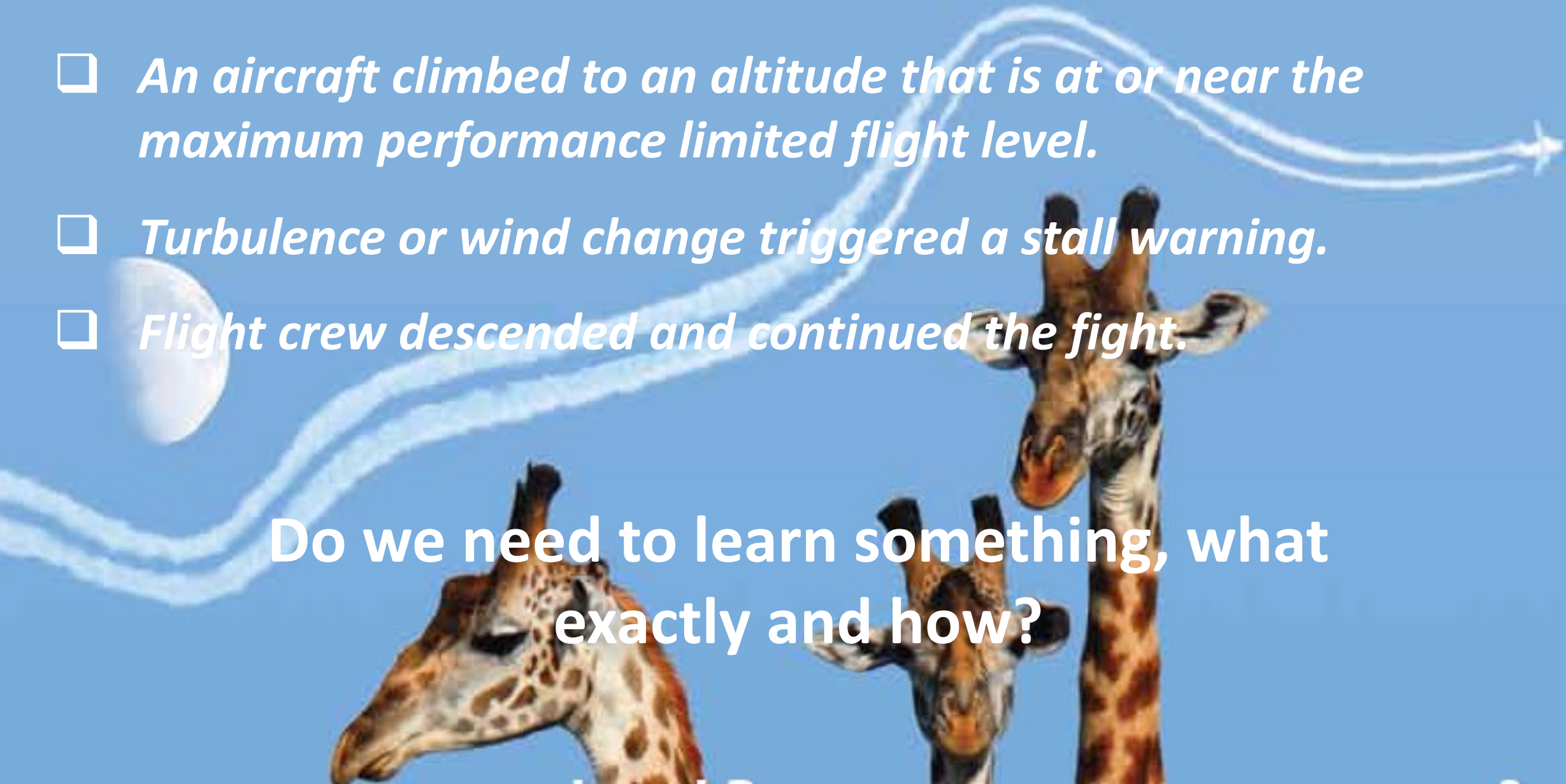
Conceptual Framework

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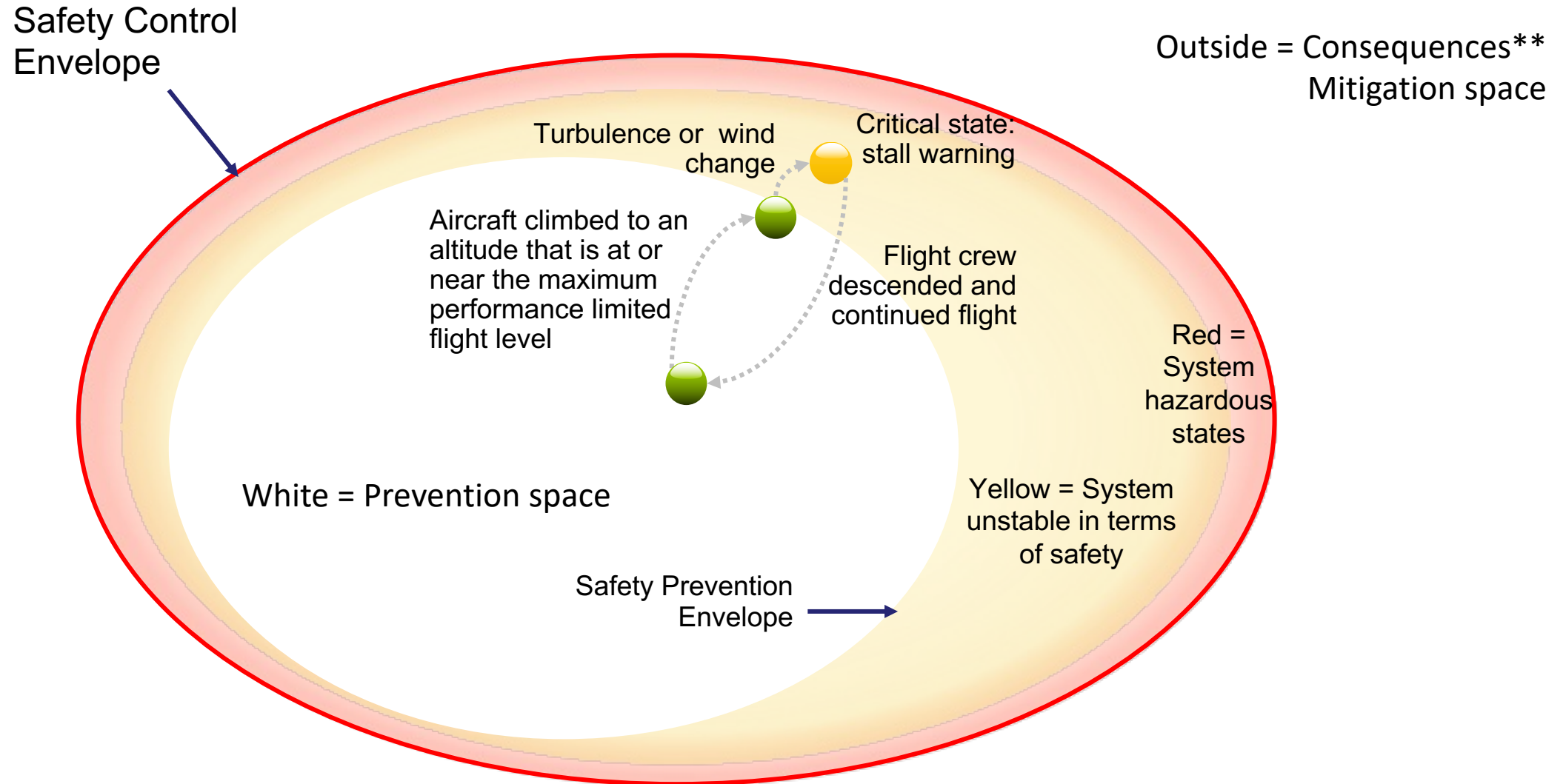
AN UNEVENTFUL EVENT

- An aircraft climbed to an altitude that is at or near the maximum performance limited flight level.*
- Turbulence or wind change triggered a stall warning.*
- Flight crew descended and continued the flight.*

Do we need to learn something, what exactly and how?



EFFICIENCY PRESSURES IN OPERATIONS

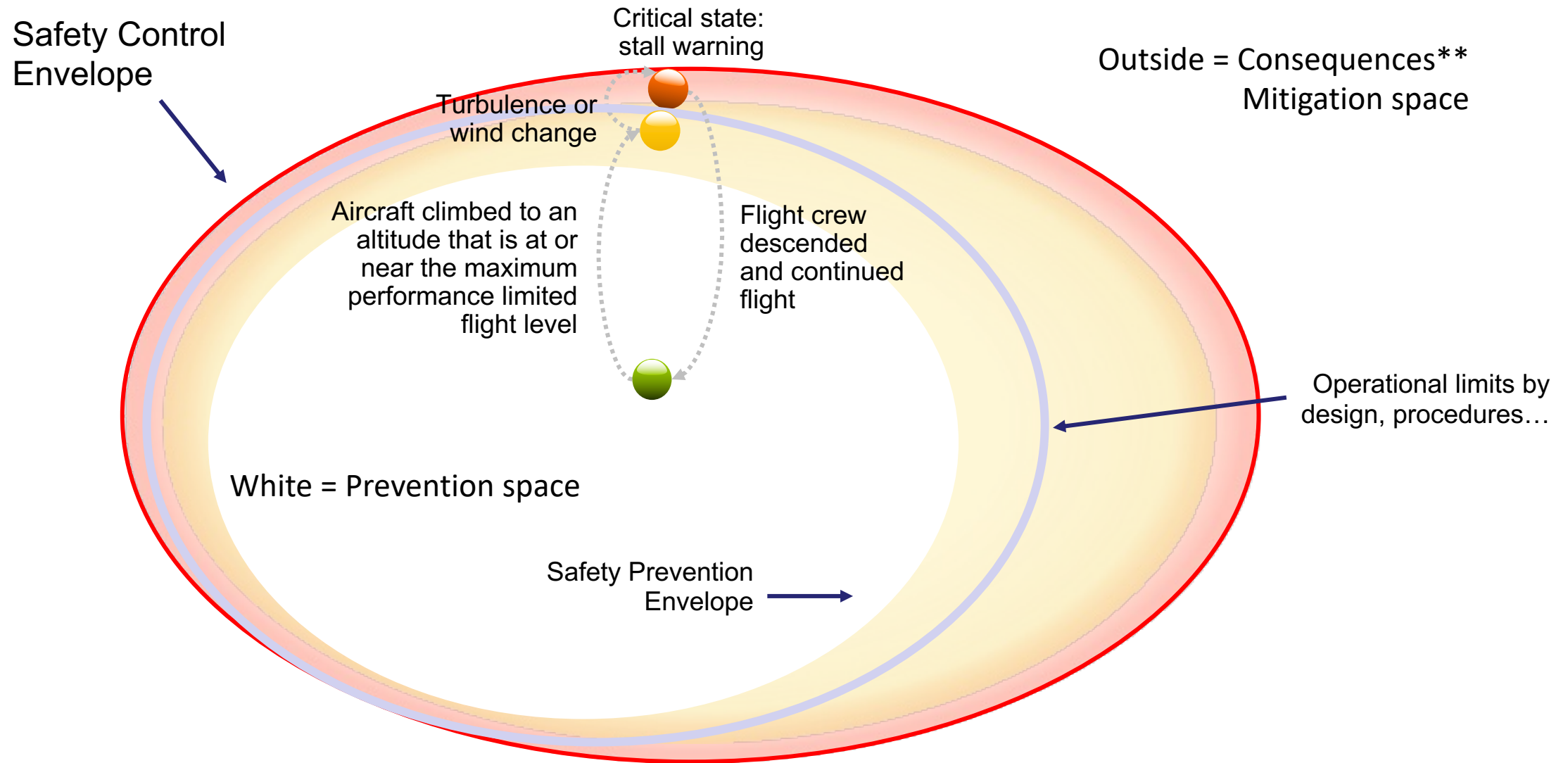


...OR SYSTEM DESIGN FLAW



Beyond the limit!

...OR SYSTEM DESIGN FLAW



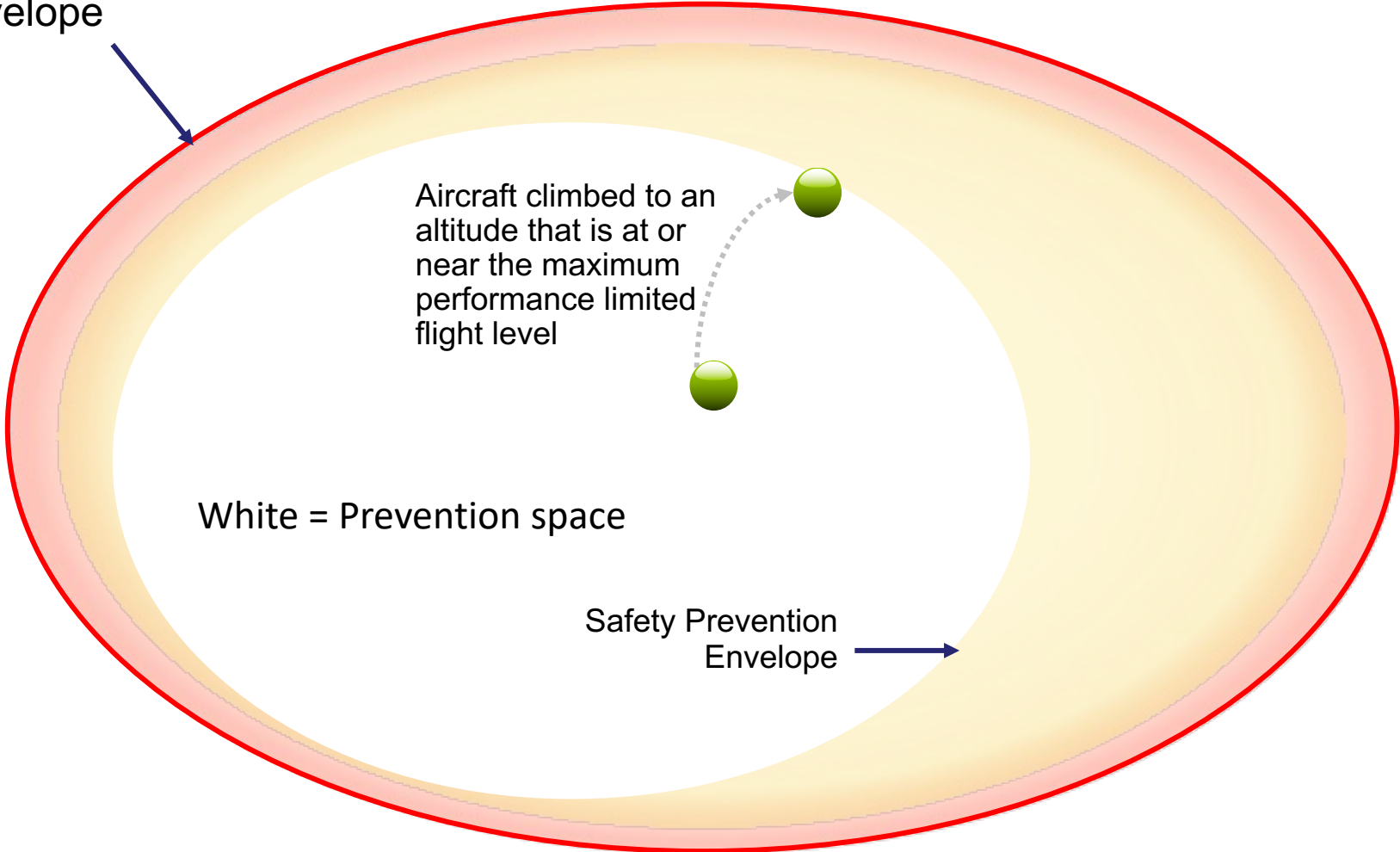
HOW ABOUT THIS STORY?

- ❑ *An aircraft climbed to an altitude that is at or near the maximum performance limited flight level.*
- ❑ *(...no turbulence or significant wind change)*

Do we need to learn something, what exactly and how?

IT CAN BE THIS – EFFICIENCY PRESSURE

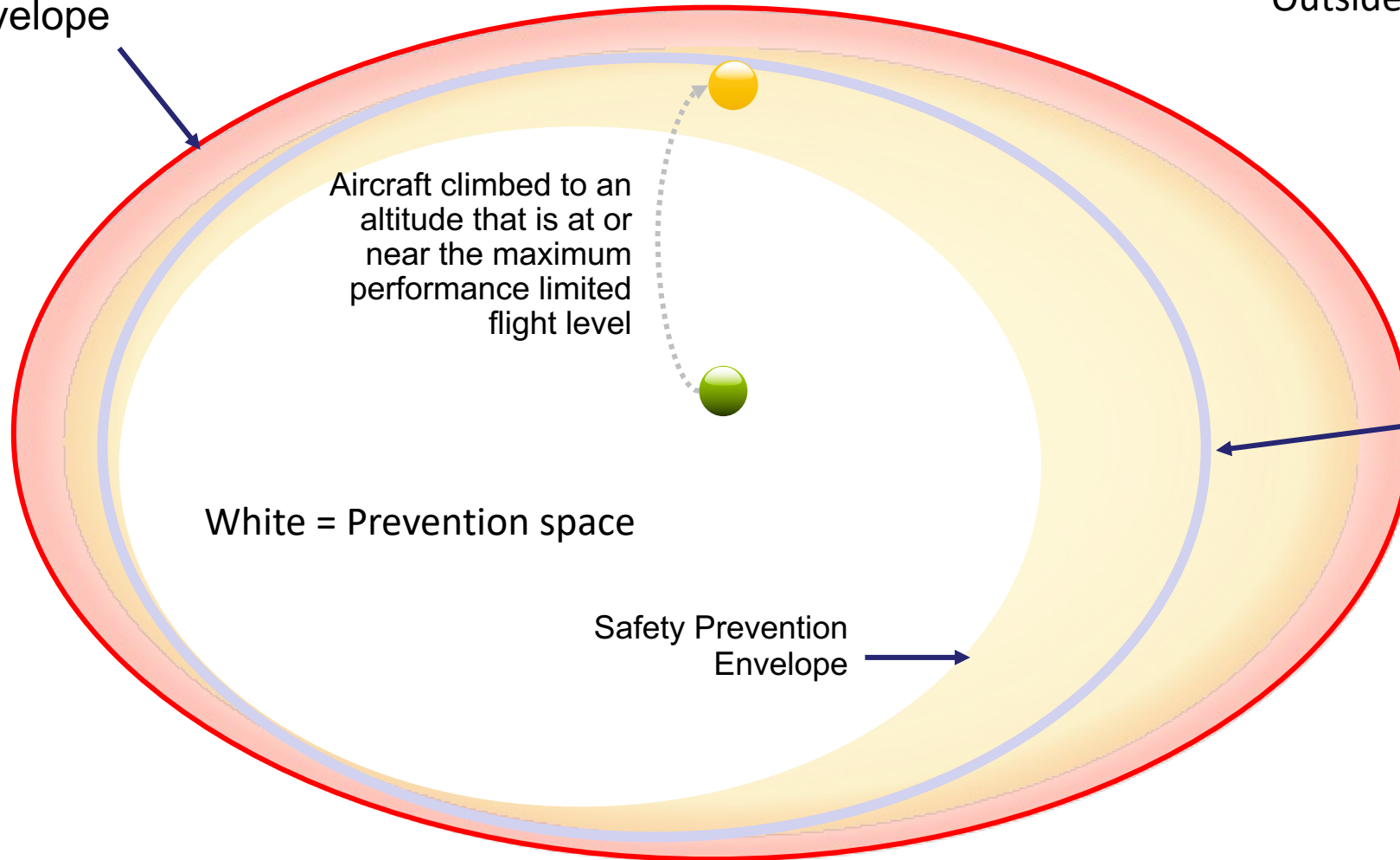
Safety Control Envelope



...OR THIS - EFFICIENCY PRESSURES + DESIGN FLAW

Safety Control Envelope

Outside = Consequences**
Mitigation space



Aircraft climbed to an altitude that is at or near the maximum performance limited flight level

White = Prevention space

Safety Prevention Envelope

Operational limits by design, procedures...

HOW ABOUT JUST THIS STORY?

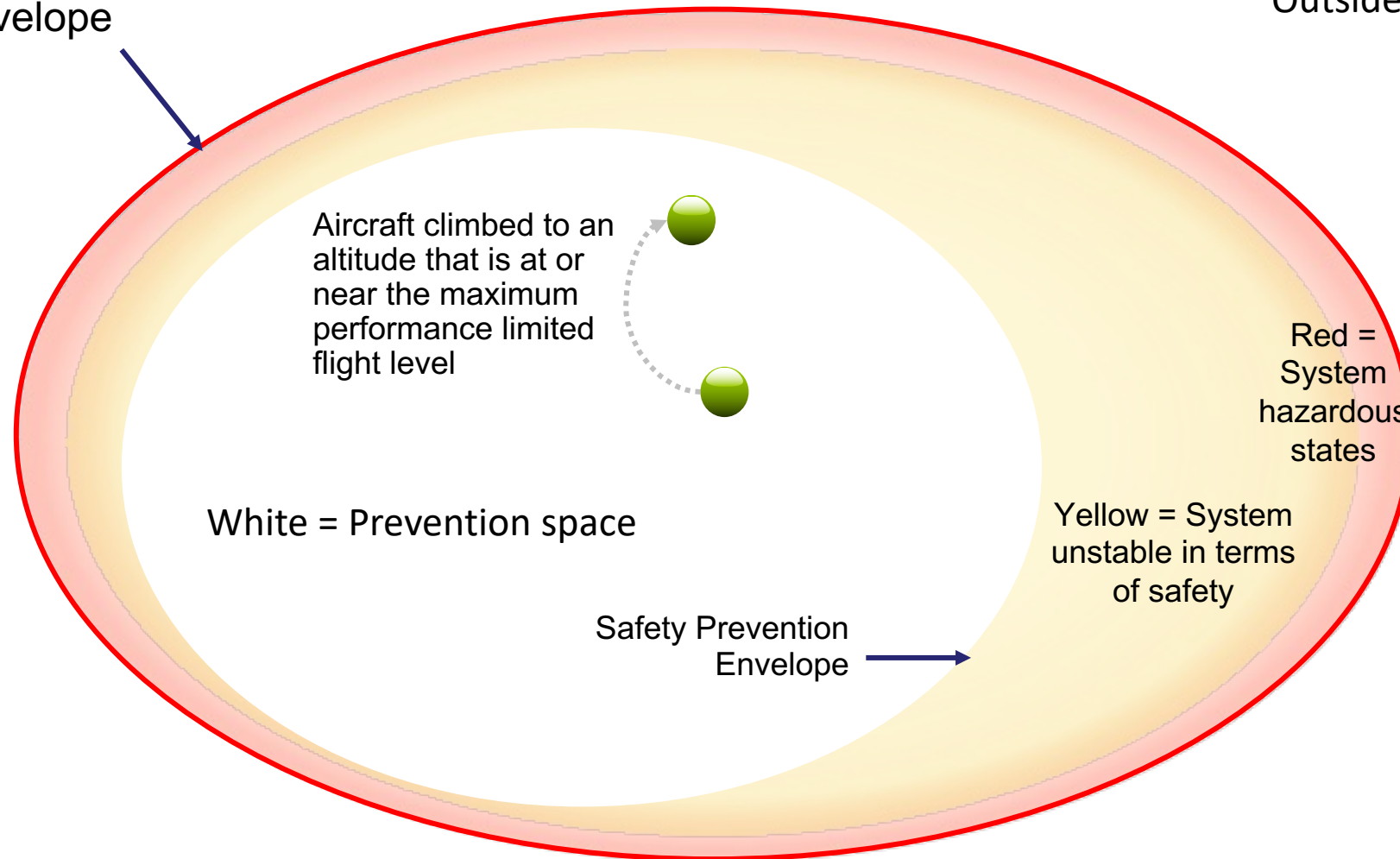
- ❑ *An aircraft climbed to an altitude that is close to but separated with a margin from the maximum performance limited flight level.*

Do we need to learn something, what exactly and how?

EFFICIENCY PRESSURES IN OPERATIONS

Safety Control Envelope

Outside = Consequences**
Mitigation space



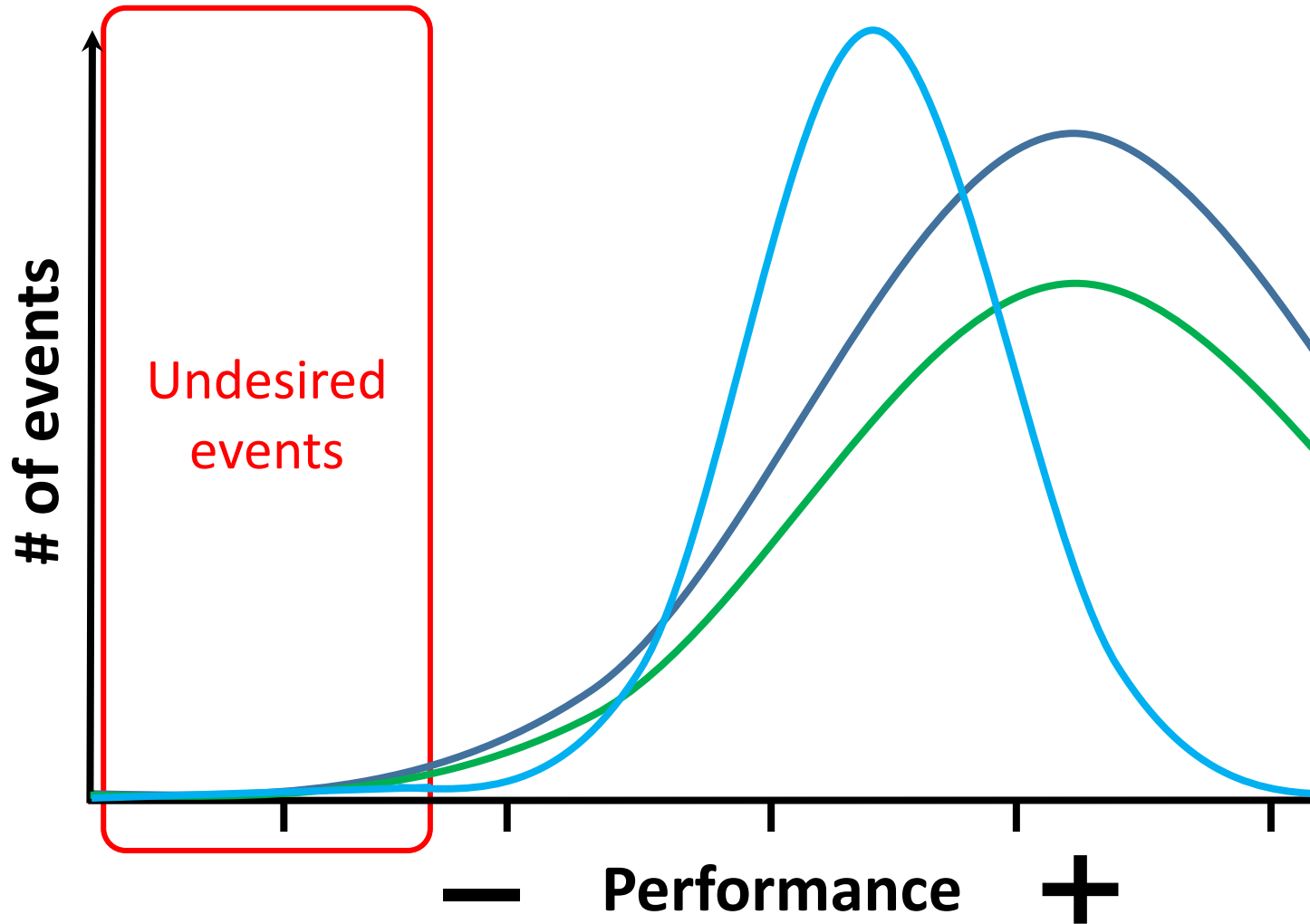
White = Prevention space

Yellow = System unstable in terms of safety

Red = System hazardous states

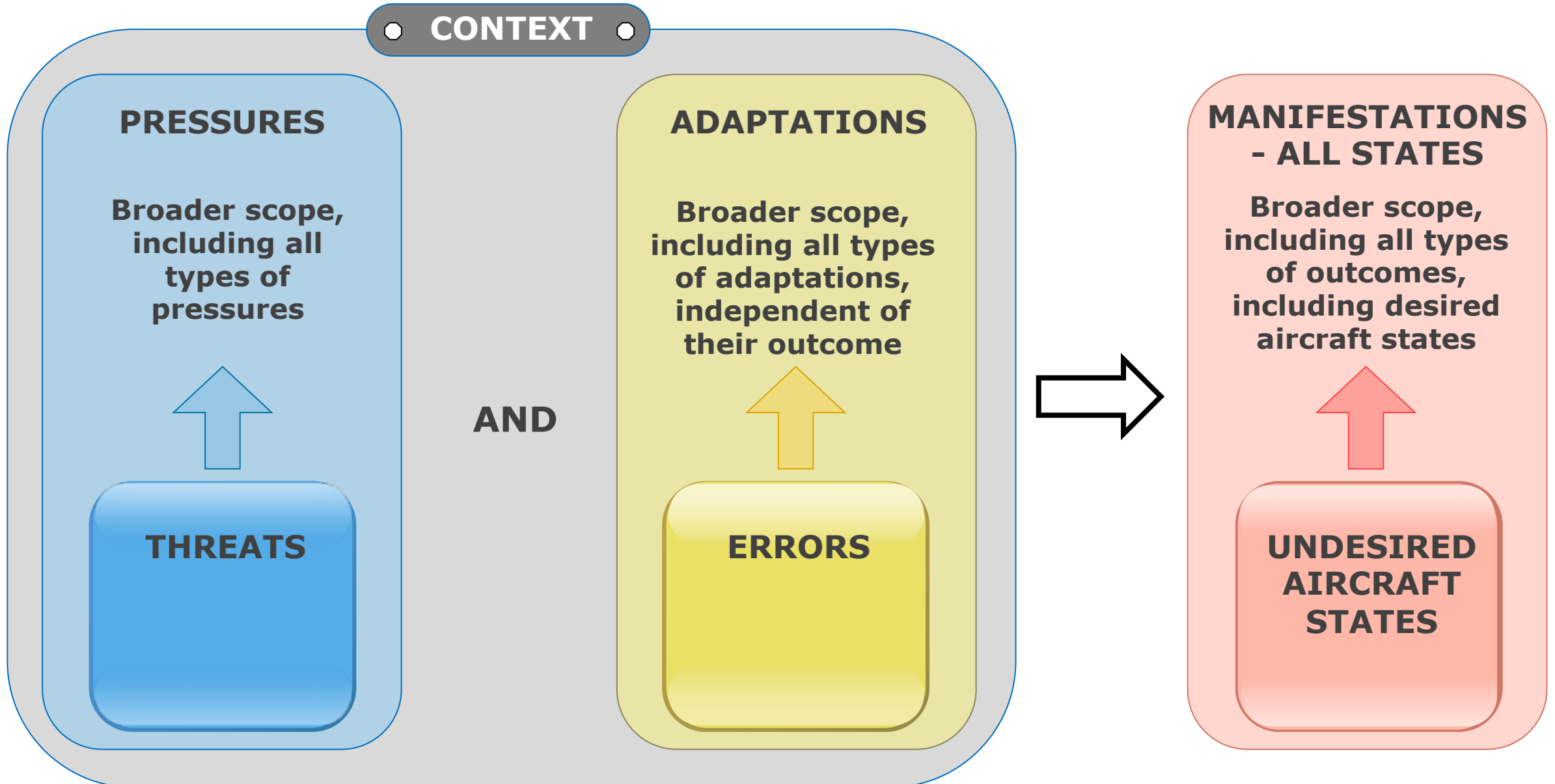
Safety Prevention Envelope

THE NEED OF UNITARY CONCEPTUAL FRAMEWORK



- ❑ **Comprehensive learning:**
 - Learning from everyday work, not just exceptional work
 - Risk, Hazard but also Resilience and Adaption
 - Integrating across data types – ‘smart data’
- ❑ **Explicit relationship safety / efficiency...**
- ❑ **Cultivate culture of continuous learning**

TEM → PAM



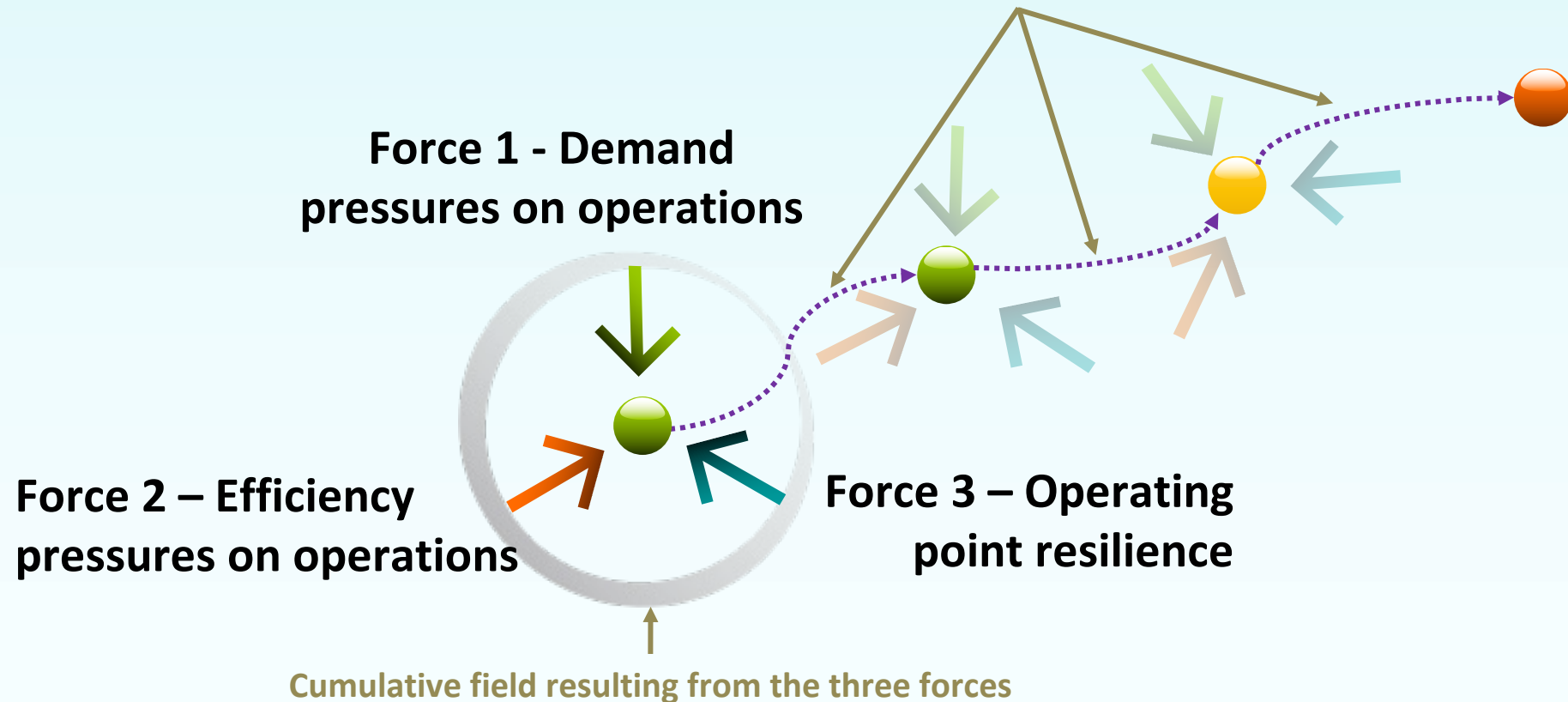
DEADLIEST ACCIDENT IN AVIATION HISTORY



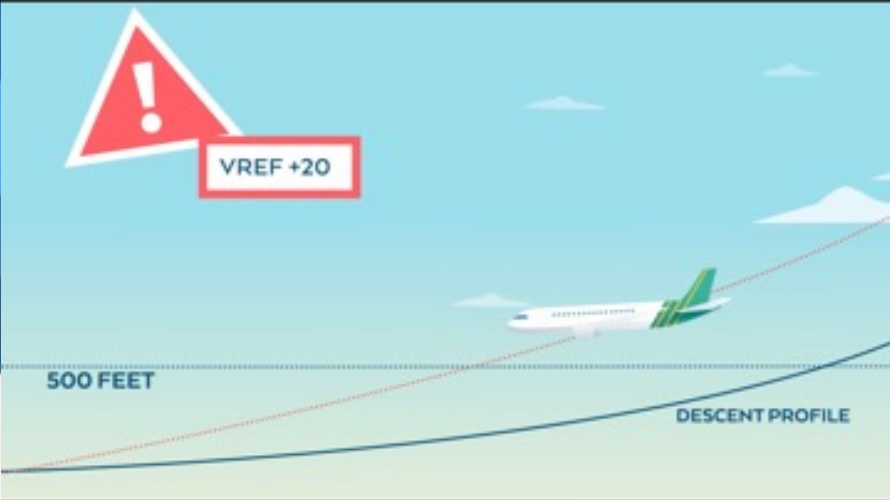
FSF 3 FORCES MODEL

CONTEXT

Adaptation can result in a change of the system operating point from an initial operating point as a result of the cumulative field of three forces



SHORTCUTS AND UNSTABLE APPROACHES



ADAPTATION

“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.”

CHARLES DARWIN

FORCE 3 - RESILIENCE

CONTEXT

Force 1 - Demand pressures on operations

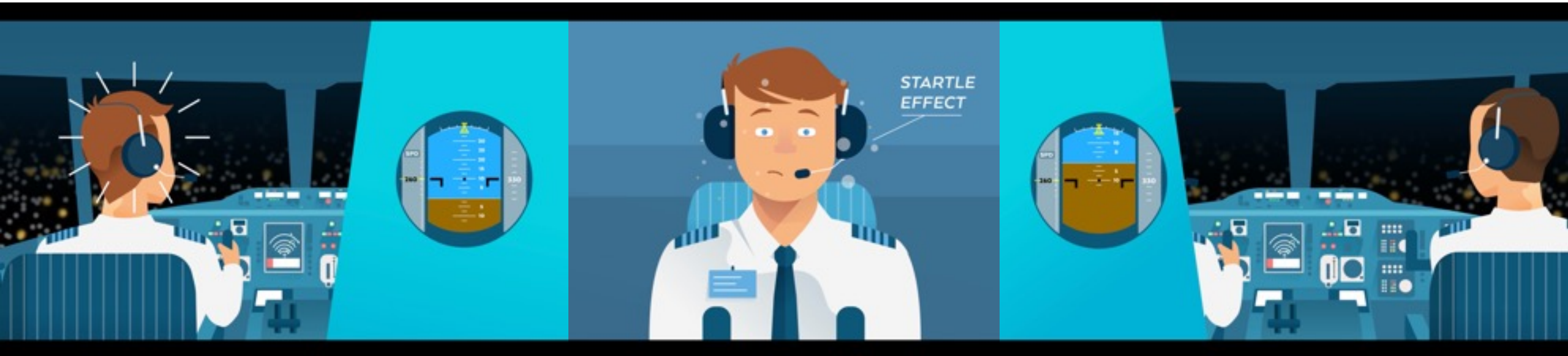
Force 2 – Efficiency pressure on operations

Force 3 - Operating Point Resilience



Four operational resilience capabilities affecting the system state adaptation and counterbalancing the pressures

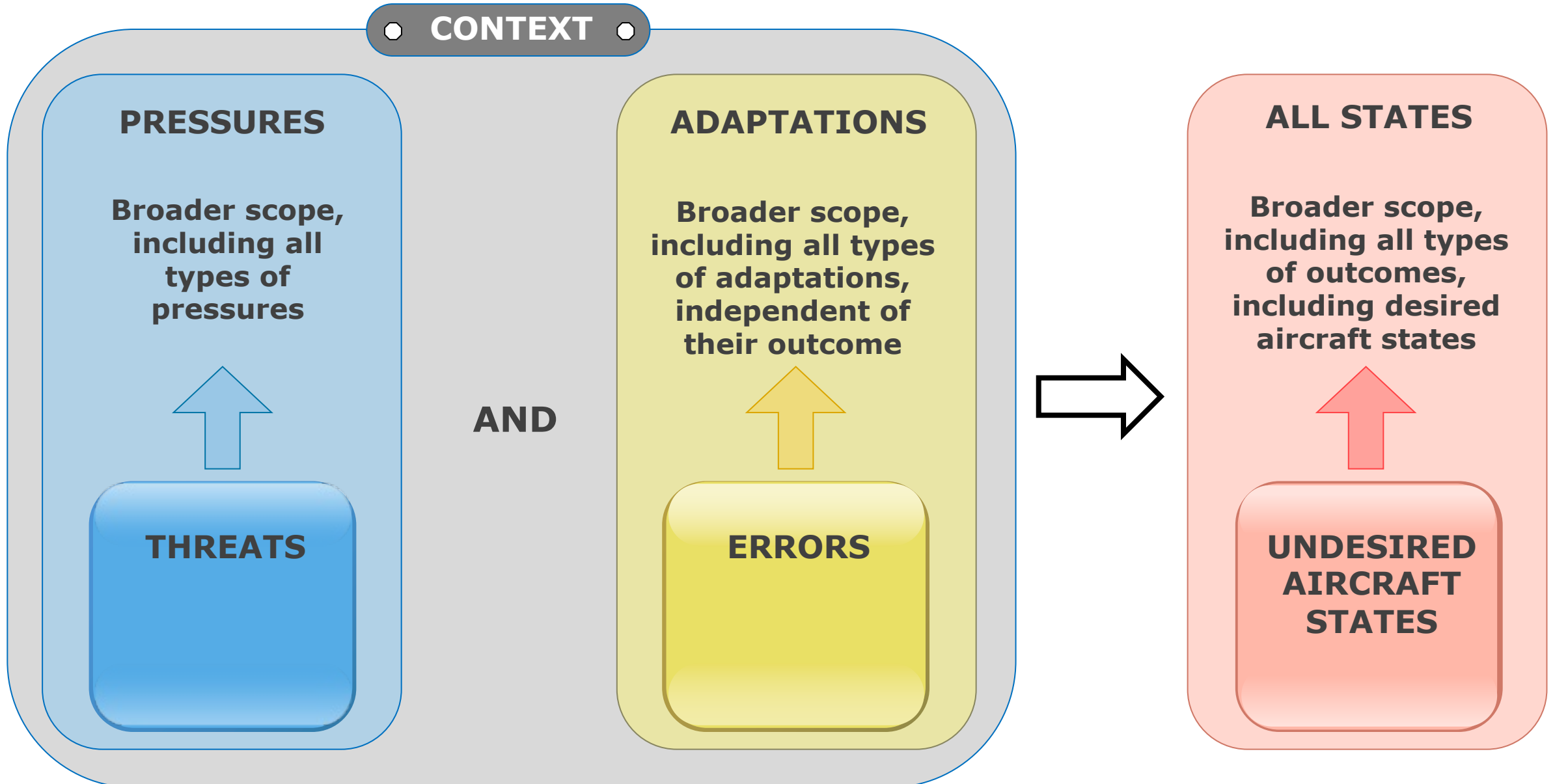
ADAPTIVE PROCESS EXAMPLE - STARTLE



ADAPTIVE PROCESS EXAMPLE - STARTLE

Pressures (potential or actual)	Plan	Coordinate	Adapt	Learn
<p>Startle effect due to combination of unexpected factors (e.g., loud noise, ECAM alert, lightning).The trade-off between the need to “sit on the hands” for some time in order for the immediate startle effects to transition and the need for prompt reaction (e.g. some assumptions are for 5 seconds of people reaction time).</p>	<p>There is no anticipation for this pressure as by its definition the combination of factors was unexpected. Prepare mentally or during briefing rehearse “black swan” events or foster crew discussion of a "plan of action" for both common non-normal events, and for the rare, "out of the ordinary" events - including pilot monitoring (PM) take over. Plan support including unexpected critical or “black swan” scenarios in the CRM and simulator training and train for “manage surprise” competence. Regularly practice manual flying skills and provide pilots with surprise/startle related events from the industry.</p>	<p>Communicate: Talk, call out observations, PF verbalize thoughts; PM use of standard call-outs. Use flight crew coordination, especially if there was unexpected reversion into manual flight. Inform ATC if unable to maintain clearance (level, heading, speed). Align through instruments cross-checking. Assistive talk/call-outs by PM.</p>	<p>PM active monitoring of pilot flying (PF) – it is unlikely both pilots to be simultaneously seriously affected by startle effect. The effects of startle to be monitored include: precipitated reaction (quickly without thought), sudden backward movement, overreaction (excessive inputs); mini-freeze (no reaction, no communication, no response when there should have been one); scream or other emotional vocalisation; cues for stress and fear (breathing, pale face, sweating); Flight crew recognise the unexpected pressures that led to startle. Flight crew apply breathing and scanning techniques. PF consider handing over control or PM consider to take control of the aircraft.</p>	<p>Reflect: Debrief and report via the SMS if needed. Practise personal control, breathing and scanning techniques. Crew resource management training on startle. Upset recovery training. Competence-based training. Reinforce flight crew confidence.</p>

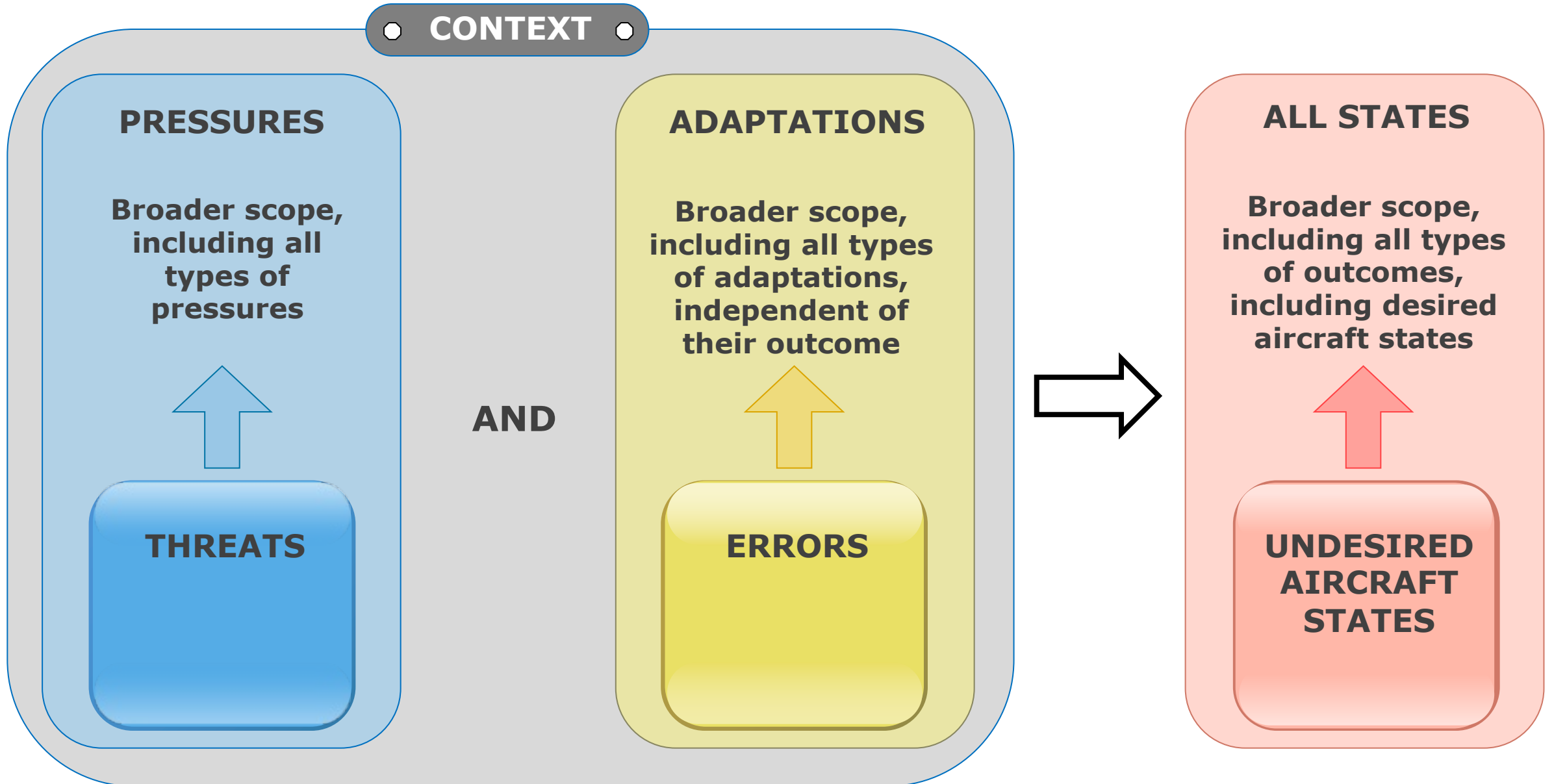
THE CONTEXT



LIMITS AS ASSUMED VS. OBJECTIVE CONTROL



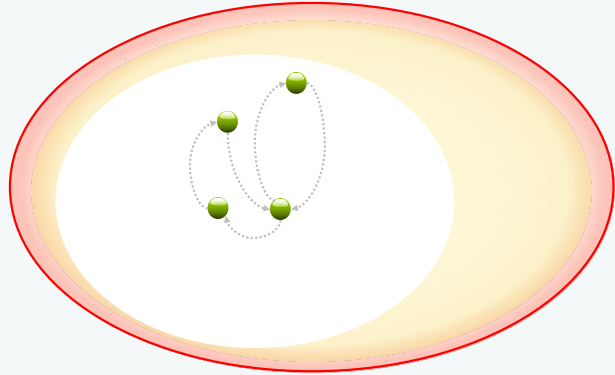
ALL MANIFESTATIONS – ALL OUTCOMES



FIVE PATTERNS OF OPERATIONAL RESILIENCE

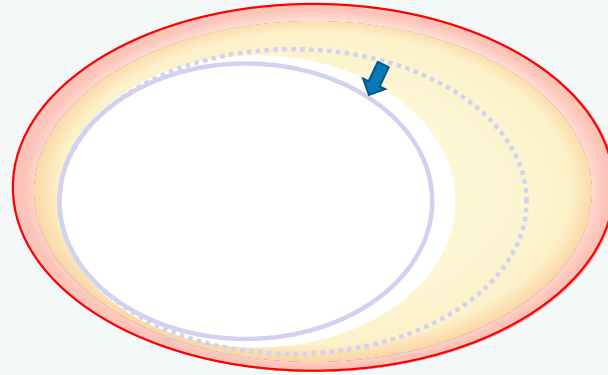
REMAINING WITHIN THE PREVENTION SPACE BY USING ABSORPTIVE AND ADAPTIVE CAPACITIES

1a



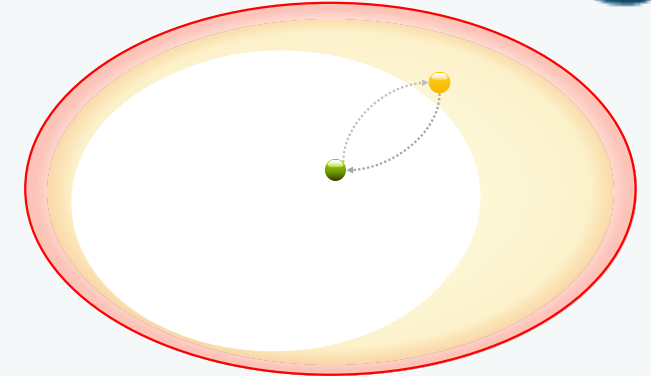
REMAINING WITHIN THE PREVENTION SPACE BY MODIFYING OPERATIONAL LIMITS

1b



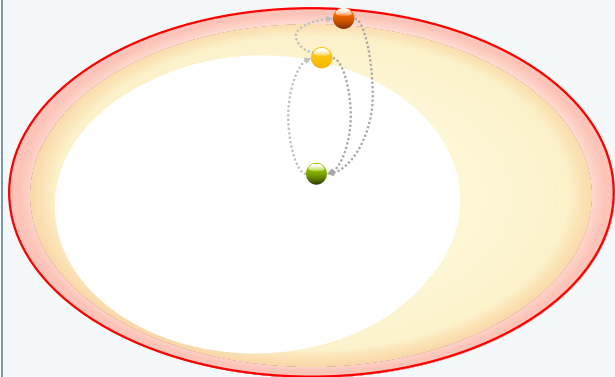
RECOVERING FROM CRITICAL STATE

2



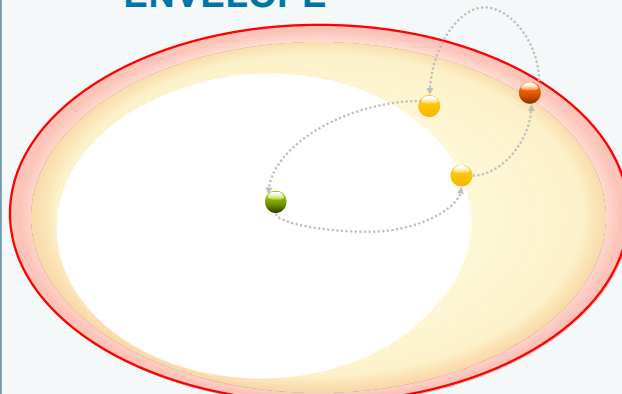
RECOVERING FROM HAZARDOUS STATE

3



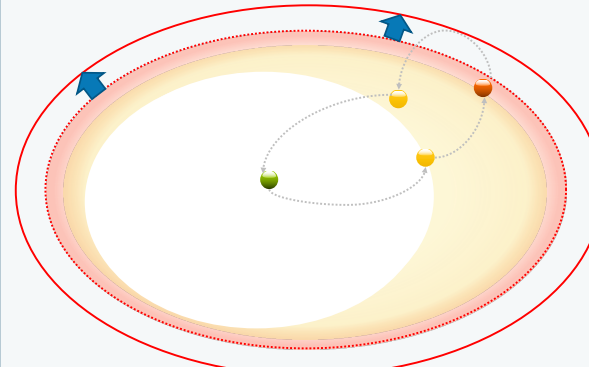
REBOUNDED BACK WITHIN SAFETY CONTROL ENVELOPE

4



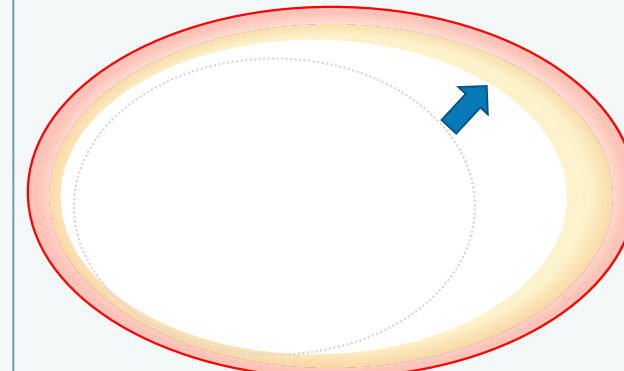
SAFETY CONTROL ENVELOPE EXPANSIONS

5a



SAFETY PREVENTION ENVELOPE EXPANSION

5b

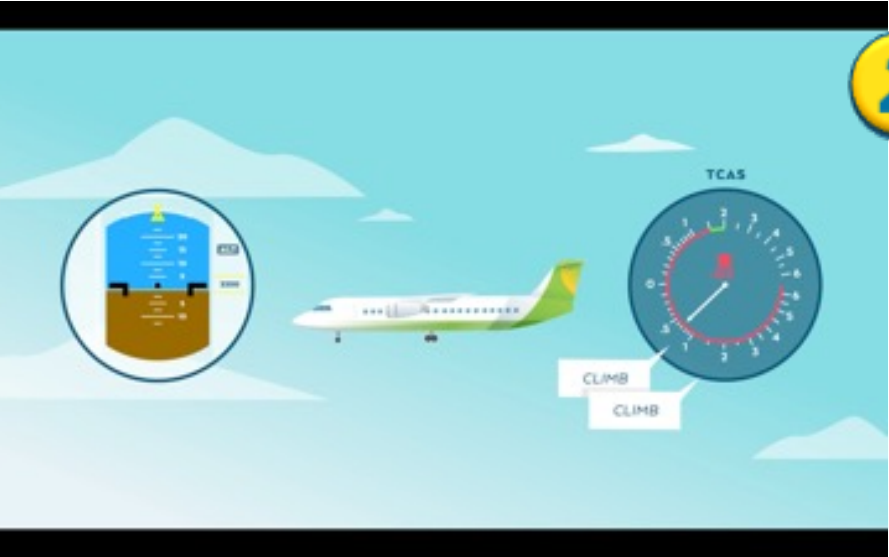


TCAS RA NOT FOLLOWED

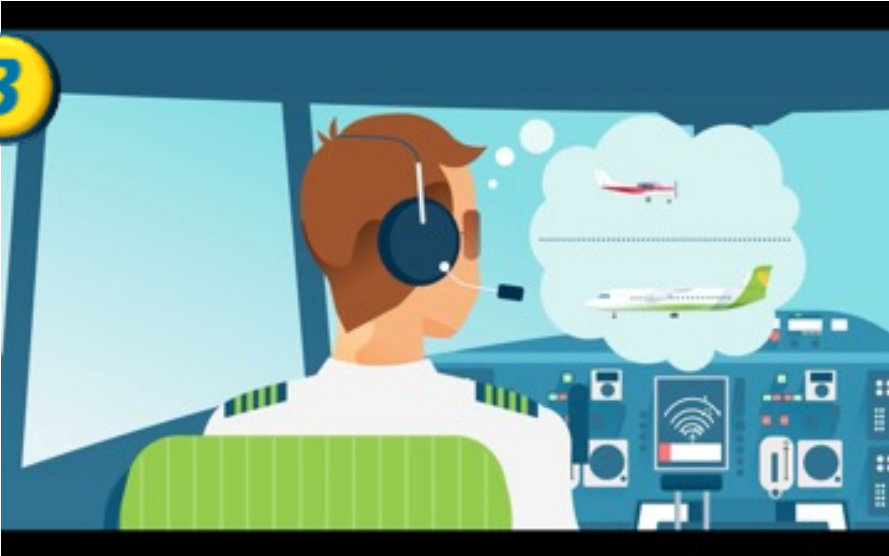
1



2



3



4



PRESSURES, ADAPTATIONS AND MANIFESTATIONS

