

## Aircraft Flight Crew Situational Awareness Considerations



Situational Awareness (SA) is often treated as a buzzword, but in the cockpit, it is the fundamental barrier between standard operations and catastrophic failure. At its core, SA is not a passive state of mind; it is an active, continuous process of perception, comprehension, and projection.

When we break down the mechanics of SA, its vulnerabilities, and the required defenses, a clear picture emerges of how optimum flight crew practices must be structured.

### 1. The Architecture of Situational Awareness

The classic model of SA relies on three distinct chronological levels. If any level is compromised, the entire structure collapses.

- **Perception (Level 1 SA):** This is the baseline collection of data. It involves scanning the primary flight instruments, monitoring engine indications, listening to ATC clearances, and observing the physical environment.
- **Comprehension (Level 2 SA):** This is where cognition transforms raw data into meaning. It is the step where a flight crew member processes *why* an indication is occurring. For example, perceiving a dropping fuel quantity indicator is Level 1; understanding that the rate of decrease indicates a structural fuel leak rather than normal consumption is Level 2.

- **Projection (Level 3 SA):** This is the ultimate goal of optimum practice—thinking ahead of the aircraft. It is the ability to project the current state of the aircraft and environment into the near future (e.g., "Based on our current fuel flow and the holding pattern instruction, what will our fuel state be upon reaching the alternate?").

This entire architecture is maintained through strict **disciplined adherence to SOPs** and **assertive, loop-closing communication**.

## 2. Systemic Vulnerabilities and Human Limitations

The human brain was not evolutionarily designed to operate complex machinery at Mach 0.8 in the flight levels. Consequently, SA is constantly under siege by inherent physiological and psychological limitations.

### Perception & Cognitive Errors

The human sensory system is easily fooled. Spatial disorientation, instrument misinterpretations, and expectation bias (hearing or seeing what you *expect* to encounter rather than what is actually happening) can corrupt Level 1 SA before processing even begins.

### The Trajectory of Fatigue & High Workload

As fatigue sets in, the cognitive processing capacity shrinks. The crew loses the ability to synthesize complex information, moving from proactive projection to reactive troubleshooting. Under high workload conditions, **task saturation** occurs. The brain sheds tasks to cope with the immediate stressor, and the very first thing typically shed is the overarching mental picture—the SA itself.

### Cognitive Bias

Once a mental model is formed, the brain naturally defends it.

- **Confirmation Bias:** The crew seeks out data that supports their initial hypothesis while ignoring glaring data that contradicts it (e.g., focusing on a successful gear-light bulb test while ignoring a nose-gear geometric indicator).
- **Plan Continuation Bias ("Get-there-itis"):** A powerful cognitive drive to complete the planned sequence of events (like an approach) despite accumulating red flags that dictate a go-around or diversion.

## The Structural Defenses: Beyond Compliance

Because human error is an inevitable variable, the aviation system cannot rely on "trying harder" to maintain SA. The defense must be systemic and structural.

### Structured CRM & Threat and Error Management (TEM)

Crew Resource Management (CRM) is the operational framework designed to mitigate human limitations. Effective CRM operationalizes TEM by identifying threats (e.g., adverse weather, system degradation, fatigue) and managing errors before they become undesired aircraft states. It requires an environment of **psychological safety** where a first officer feels entirely empowered to challenge a captain's actions if a deviation is perceived.

### The Role of the Monitoring Pilot (PM)

Optimum practice dictates that the Pilot Monitoring (PM) role is just as critical, if not more so, than the Pilot Flying (PF). Continuous monitoring is the mechanism that catches drift. When the PM actively monitors the flight path, automation states, and systems, they act as an independent validator of the PF's mental model.

### Proactive Planning and Briefings

The flight briefing should never be a rote reading of a card. It is a proactive planning tool used to build a *shared mental model*. A robust briefing addresses the "what ifs," defining explicit triggers for a go-around, diversion, or intervention. This removes the cognitive load of decision-making during high-stress, time-critical moments.

### The Recovery Paradox: The Difficulty of Regaining SA

Maintaining SA requires relatively low cognitive energy compared to recovering it once it is lost.

When a crew loses SA, they enter an operational vacuum. They are reactive, behind the aircraft, and highly susceptible to severe task saturation. Because recovery is incredibly difficult and highly time-critical, the optimum practice for regaining SA follows a strict, non-negotiable hierarchy:

1. **Aviate:** Stabilize the aircraft. If in doubt, climb, hold, or execute a go-around. Buy time and altitude.
2. **Navigate:** Ensure the aircraft is heading toward a safe, un-obstructed sector.
3. **Communicate:** Declare a state or request assistance from ATC if needed (e.g., requesting a holding pattern to sort out a technical issue rather than accepting vectors into a high-workload terminal area).

4. **Re-assess:** Utilize all available resources—instruments, automation, checklists, and each other—to rebuild the mental picture from Level 1 up.

The moment a crew member realizes they do not know exactly what the aircraft is doing, or what it will be doing in the next two minutes, the baseline practice is to step back, reduce the immediacy of the threat, and actively reconstruct the picture before taking further decisive action.