Threat and Error Management

IFR Study Club

June 10, 2020

What is Threat and Error Management?

- A risk management or risk mitigation tool
- Goals of Threat & Error Management
  - Identify and recognize Threats
  - Reduce Errors
  - Prevent Undesired Aircraft States (UAS)
- Decision-making is at the core of TEM

The Goal of Threat & Error Management

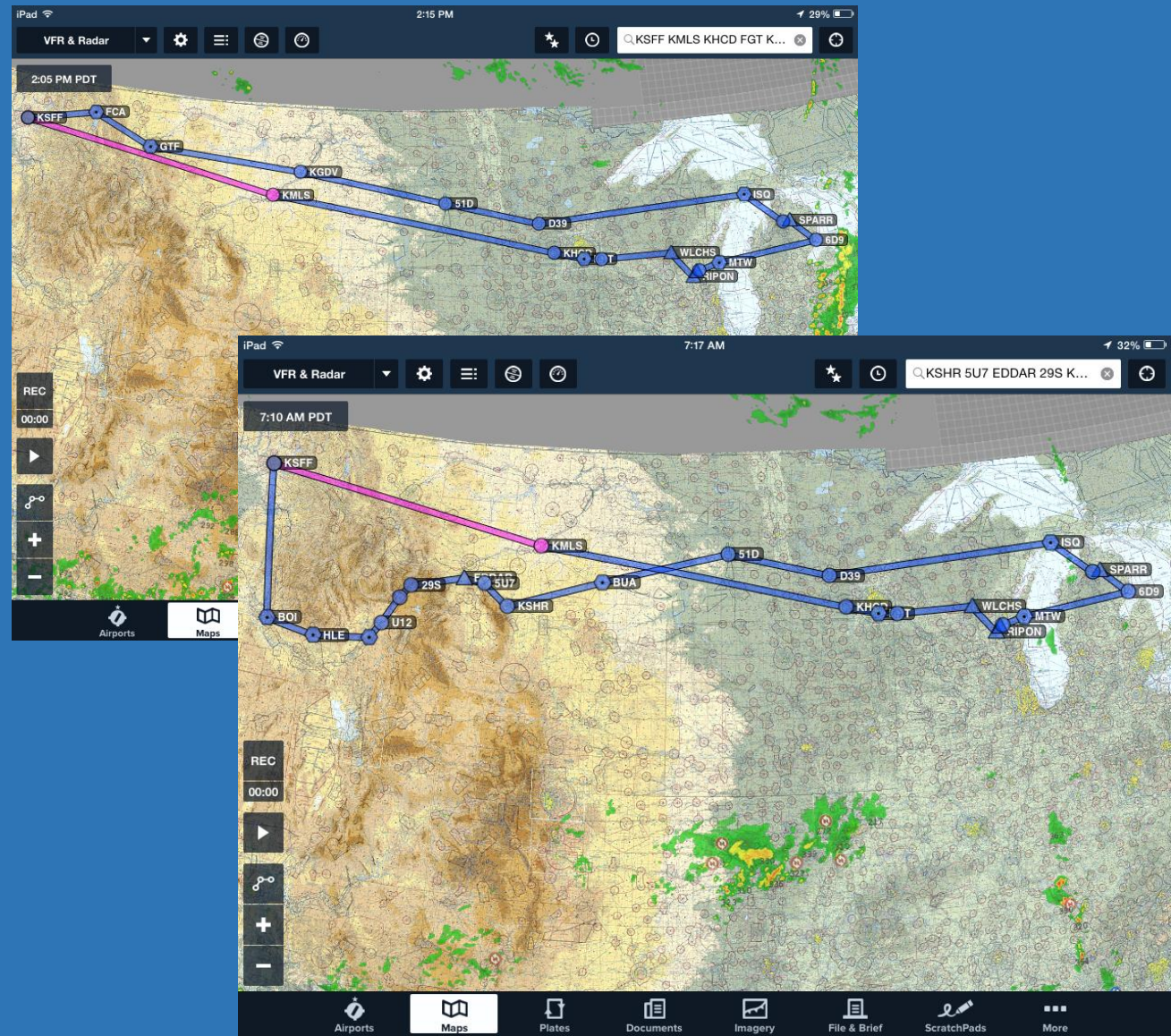
- Identify & Recognize Threats
- Reduce Errors
- Prevent Undesired A/C States (UAS)
  - UAS can range from incorrect flap settings to exceeding the A/C's flight envelop

The Goal of Threat & Error Management

- Help recognize and prevent the accumulation of mistakes which can escalate into operational errors
  - AKA “The Accident Chain”
- Accidents are rarely the result of a single event or error
  - Break the chain early
- Ultimately, must become aware of Threats & Errors that constitute the initiation of the “Accident Chain”

Components of Threat & Error Management

1. Threat
   - An Event or Situation that occurs outside the Pilot's ability to influence
2. Error
   - A Pilot Action or Inaction that leads to a deviation from intentions or expectations
3. CRM/SRM
   - Crew (Cockpit) Resource Management/Single-Pilot Resource Management
4. Undesired A/C State
   - An aircraft's position, speed, Alt, or configuration resulting from pilot error, actions, or inactions resulting in reduced Safety Margins



1. What is a Threat?

- An outside (uncontrollable) event that increases the operational complexity of a flight
  - Requires attention/management to maintain safety margins
  - For instance:
    - Adverse weather, terrain, congested airspace, aircraft malfunctions, errors committed by people outside of the cockpit (ATC, maintenance workers)

Three Categories of Threats

- Operational Threats
  - Equipment malfunction, closures on an airfield
- Environmental Threats
  - Weather, ATC
- Mismanaged Threats
  - Inappropriate control inputs
    - Not extending the landing gear
    - Not handling an engine out (single or multi)
    - Improper speed for flight condition

Threats not Addressed

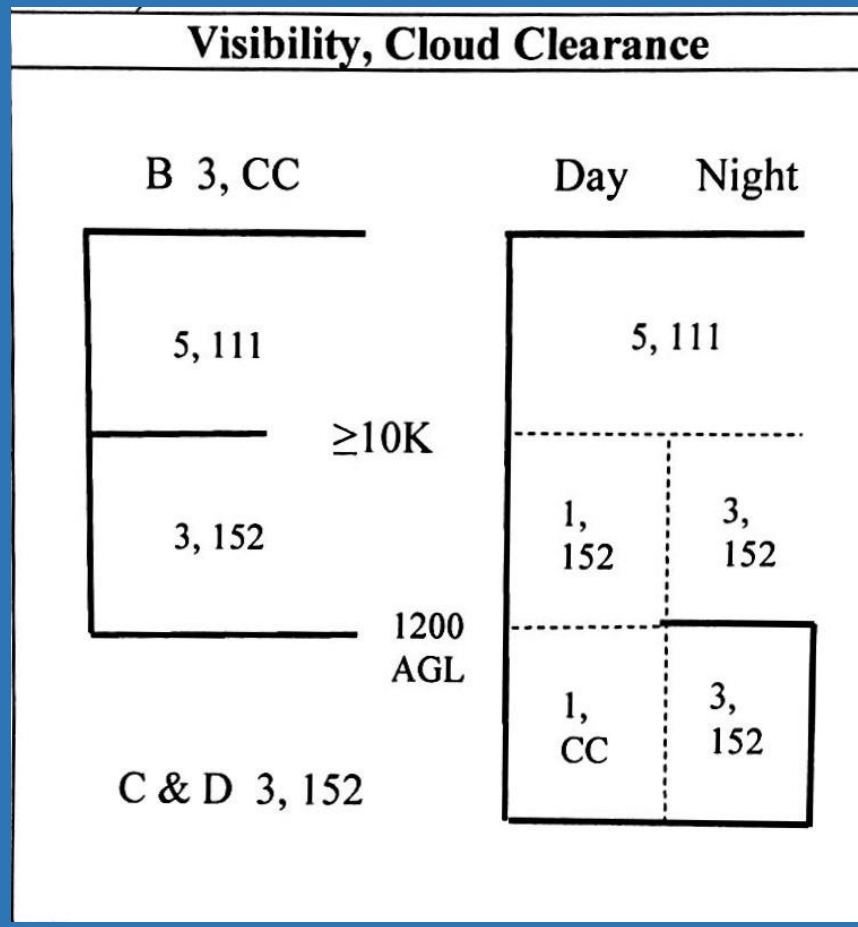
- Improperly addressed threats will often introduce another threat
- Properly addressed threats help mitigate the impact of the event of situation.

2. What is an Error?

- An action or inaction that reduces safety margins
- An action or inaction that increases the probability of adverse operational events on the ground or in flight
- Can arise from observable events or situations as well as from decisions made about those situations
  - For instance VMC into IMC

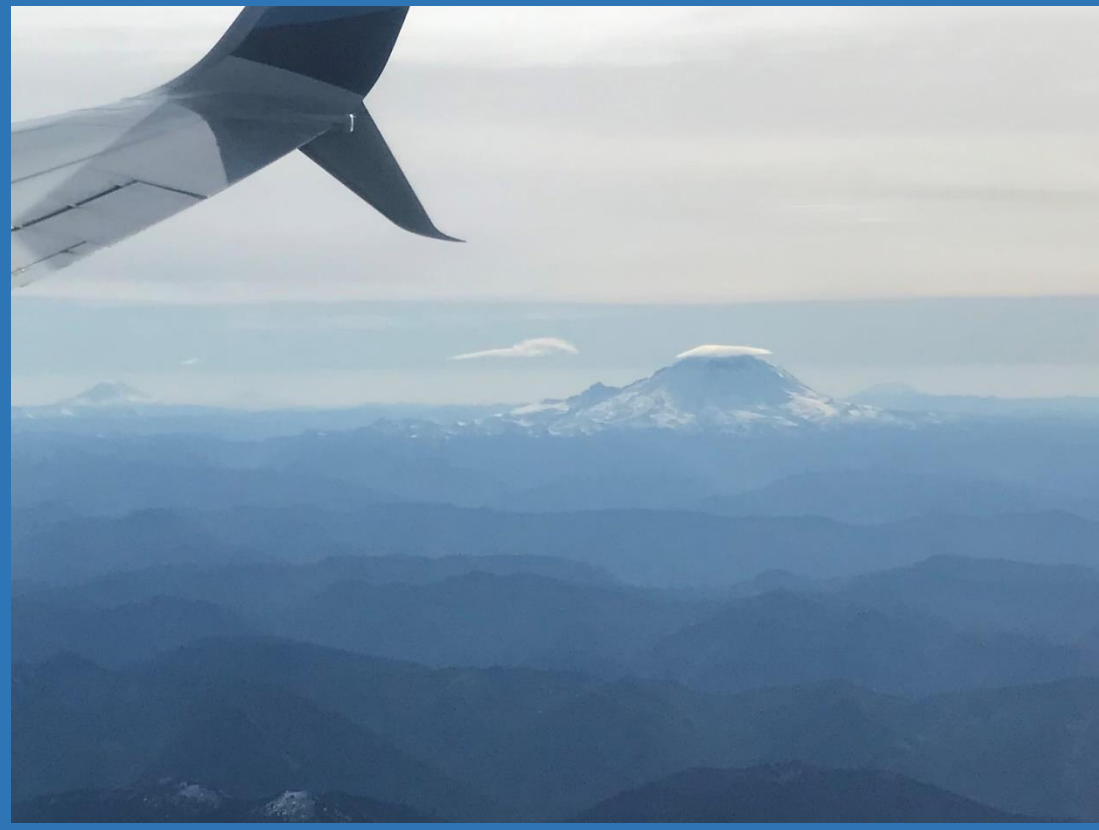
Three Categories of Errors

- Aircraft Handling Errors
  - Speed, configuration, automation
- Procedural Errors
  - Intentional or unintentional
- Communication Errors
  - Misunderstandings
    - Pilot and ATC
    - Between Crew
    - Between Crew and Passengers



Interplay of Threats and Errors

- Errors do not always arise from Threats
  - Selecting flaps above published flap operating speed is an error that may not be associated with any threat
- Threats come at you, Errors come from you



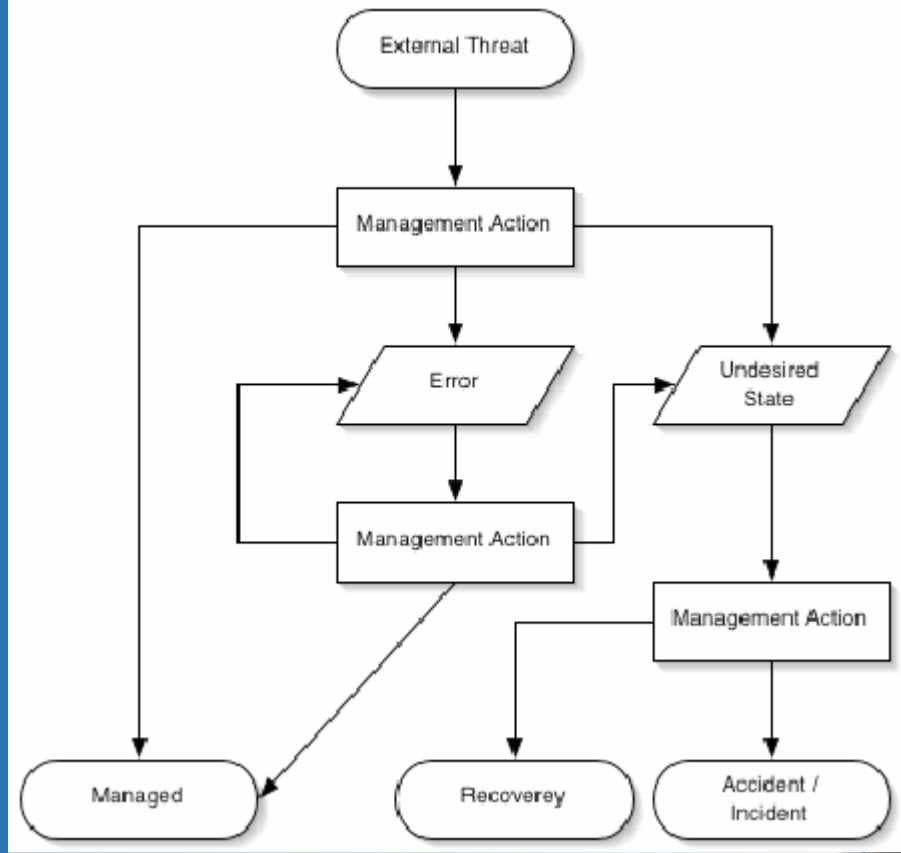
Decision-making

- Most of us do not make good decisions under Time Pressure

- Time pressured decisions are mitigated by staying ahead of the situation
  - “Stay ahead of the airplane”
  - “He was behind the airplane from the start”

Decision-making

- Mitigate Time Pressured Decision-making with practice
  - Time/Experience in your airplane (or profession)
  - Simulators/simulation
- Difficult with an aircraft new to you
- Difficult in a familiar aircraft with new systems (such as avionics)
  - Especially if multiple components are replaced at the same time!



The Big Picture of Decision-Making

- Commonly we make Decisions without the luxury of time during any Flight Segment
- Typically the Decisions are Routine
  - Challenging Decisions become more routine with Experience

Experience

- “Experience is the best teacher”
- “We learn from our mistakes”
- Definition:
  - The process or fact of personally observing, encountering, or undergoing something
- Helps us build an internal database of answers

Experience

- Since Experience is the best teacher and we learn from our mistakes …
  - Making mistakes are part of the learning experience and are INEVITABLE
- Our goal is to minimize the severity of the mistake(s)
  - Big mistakes are generally the cumulative result of small mistakes
  - “Breaking the chain”

Managing Risk

- Experience
- Essential to safely doing Anything!
- Risk is never “Zero”
  - Therefore it must be assessed, then managed.

Assessing the Risk

- Pilot Self-Assessment
- Aircraft Preflight
- Flight Planning Services
  - Pre-Flight
  - En Route

Assessing Risk – Preflight Decision-Making

- Flight Planning Services
  - NOAA, AOPA, ForeFlight, Garmin Pilot, etc.
- Lots of options for analyzing the flight and en route weather
  - Probably as many variations as individuals in this room.

Assessing Risk – En Route Decision-Making

- Airborne Technologies
  - Especially ADS-B
  - Sirius XM Weather
  - Airborne Radar
  - Stormscope
  - Flight Service Station

- Any of these options gives us the opportunity to make good en route decisions
  - Onboard weather options provide a wealth of information instantly relative to the time it takes for a radio call
  - The radio call still has value, unbiased input

Risk Management in Aviation

- The Aviation Environment is Complex
  - We will make mistakes
  - The Perfect Flight doesn't exist!
- Aviate, Navigate, Communicate
  - + Mitigate!
- Risk Mitigation requires that we know what the Risks are
  - Airlines adopted Threat & Error Management

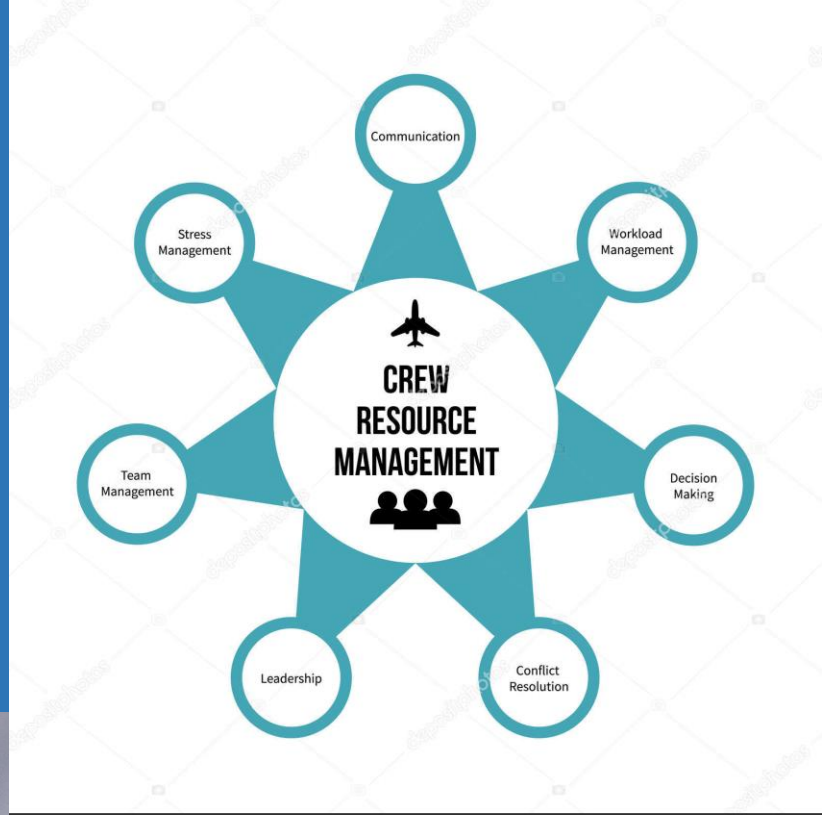
3. Crew (Cockpit) Resource Management

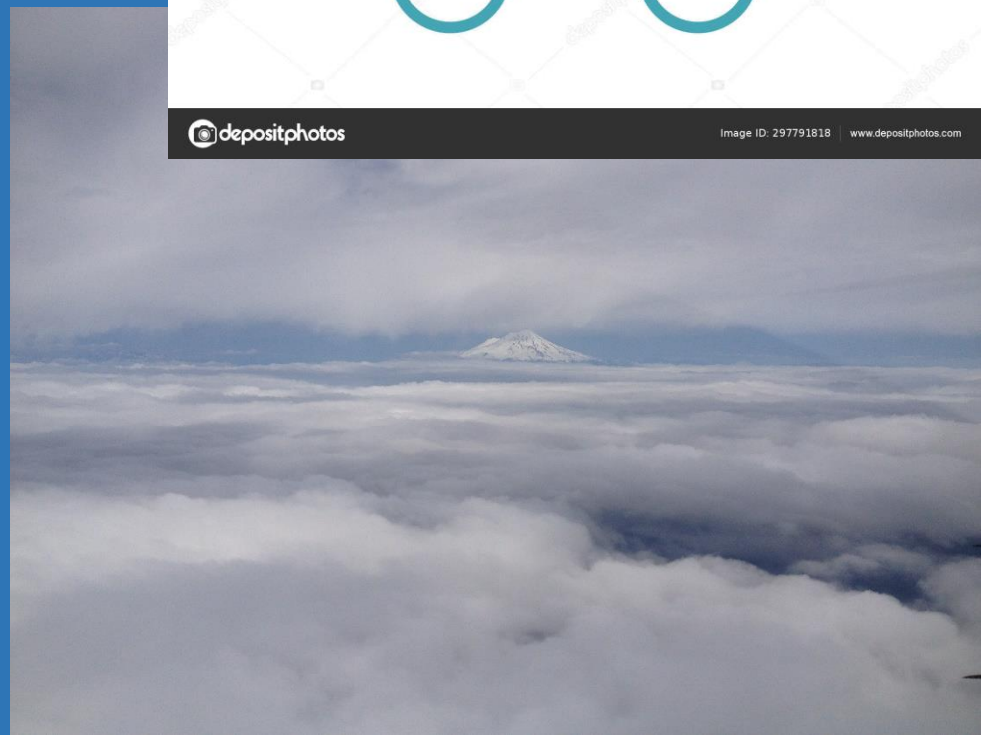
- Introduced in 1981 to address the authoritarian attitude of captains
- In the 1990's "Cockpit" was replaced by "Crew"
  - Team building techniques
  - Synergies like crew briefing
- CRM is about leveraging all available resources to help manage the flight
  - The entire system plays a role in safety

Crew Resource Management

- No single person has the full picture
  - Every person has something useful to contribute toward developing the full picture

- You cheat yourself if you fail to take advantage of all available information needed for safe operation



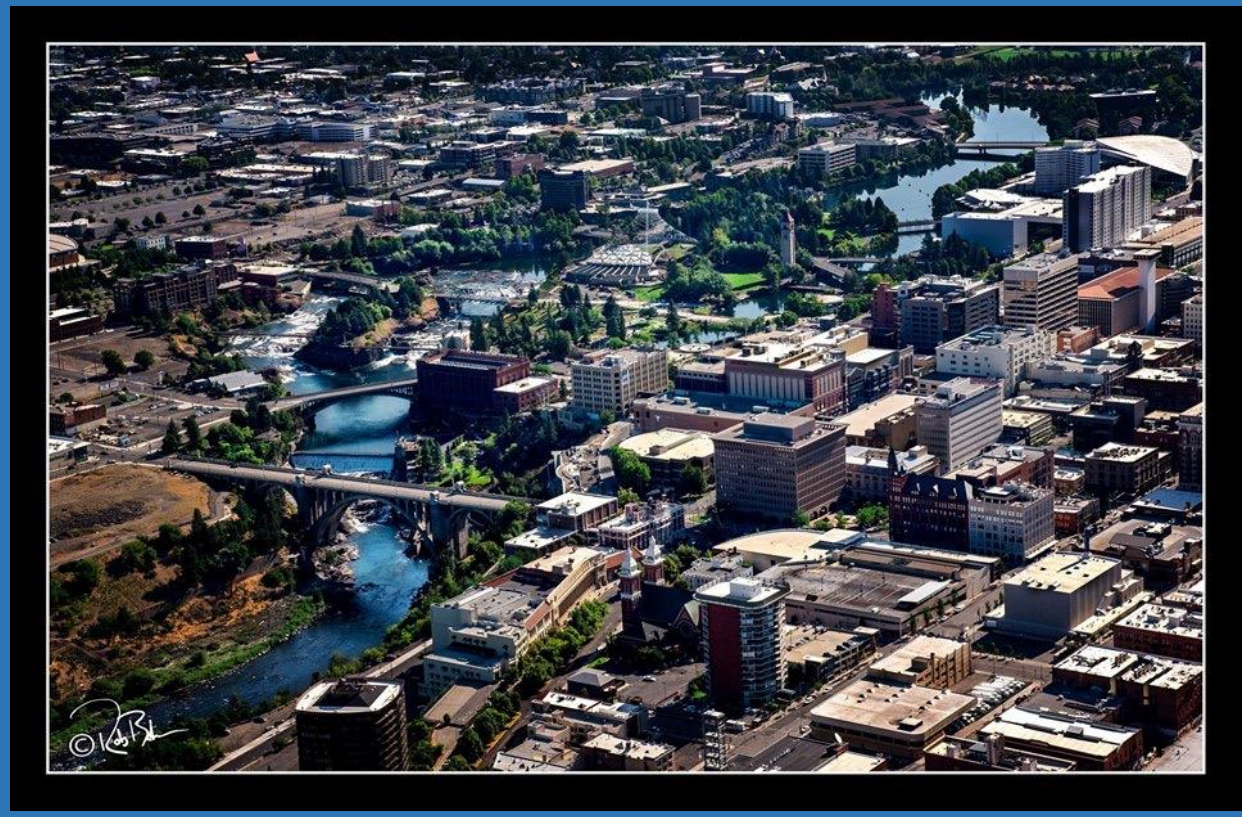


Crew Resource Management Components

- A system that uses all available resources to promote safety
- Concerned with the cognitive and interpersonal skills needed to manage resources within an organized system (not technical knowledge and skills)
- Foster a climate or culture where authority may be respectfully questioned

Crew Resource Management Skills

- Communications
- Situational awareness
- Problem solving
- Decision-making
- Effective teamwork
- These skills may require significant changes in personal habits, interpersonal dynamics, and organizational structure
- PIC must be trained to understand and accept that questions and observations are not a threat to their final authority



CRM in GA

- The non-flying pilot (or knowledgeable pax) must not attack and the flying pilot must acknowledge
  - Get Attention (use name)
  - State your concern (direct statement w/o emotions)
  - State the problem as you see it
  - Suggest a solution (a plan)
  - Obtain agreement (or buy-in with the plan)

Single-pilot Resource Management

- A tool that individual pilots can use to achieve CRM for the Single-pilot to leverage all available resources to help manage the flight

- View ATC and Flight Service as part of the crew (Autopilot, iPad, Passengers, ADS-B)

- Flight Planning tools/Technology
  - GPS, ADS-B

Single-pilot Resource Management

- What is SRM?
  - The art of managing all resources, both those onboard and those from outside sources, to ensure a successful flight (FAA “Risk Management Handbook FAA-H-8083-2)
- The Aeronautical Decision-Making process
  - The analysis of each situation in light of experience level, personal minimums, current physical & mental readiness level, and drawing a conclusion to make a decision
- It is about how to gather information, analyze it, and make decisions

Single-pilot Resource Management

- Perform cognitive tasks as well as airmanship tasks
  - Situational awareness
  - Task management
  - Automation management
  - Risk management
  - CFIT awareness

Single-pilot Resource Management

- An Art
  - Identify problems
  - Analyze information
  - Make informed & timely decisions
- Ultimately
  - Learning how to judge a situation
  - Learning “how to think” in the dynamic environment of a flight
- SRM Resources
  - ATC
  - On-board equipment
  - Pax: checklist, traffic, listen for radio
    - Freq Pax: radios, GPS, briefings

Application of SRM

- Utilize 5-P's at key decision points during flight
  - Plan
    - Reevaluate at regular intervals
  - Plane:
    - Monitor systems
  - Pilot:
    - Assess your fitness for flight
  - Pax:
    - Can be an asset or a distraction
  - Programming:
    - GPS, Autopilot, Electronics
- Consistent use is the key to developing SRM skills to enhance the safety of flight

Wx, Route, Fuel, Current Publications, Etc.

Be proficient with all installed equipment, performance characteristics and limitations

Illness
Medications
Stress
Acohol
Fatigue
Enough nourishment

Can be an asset as long as physiologically and psychologically they are comfortable.

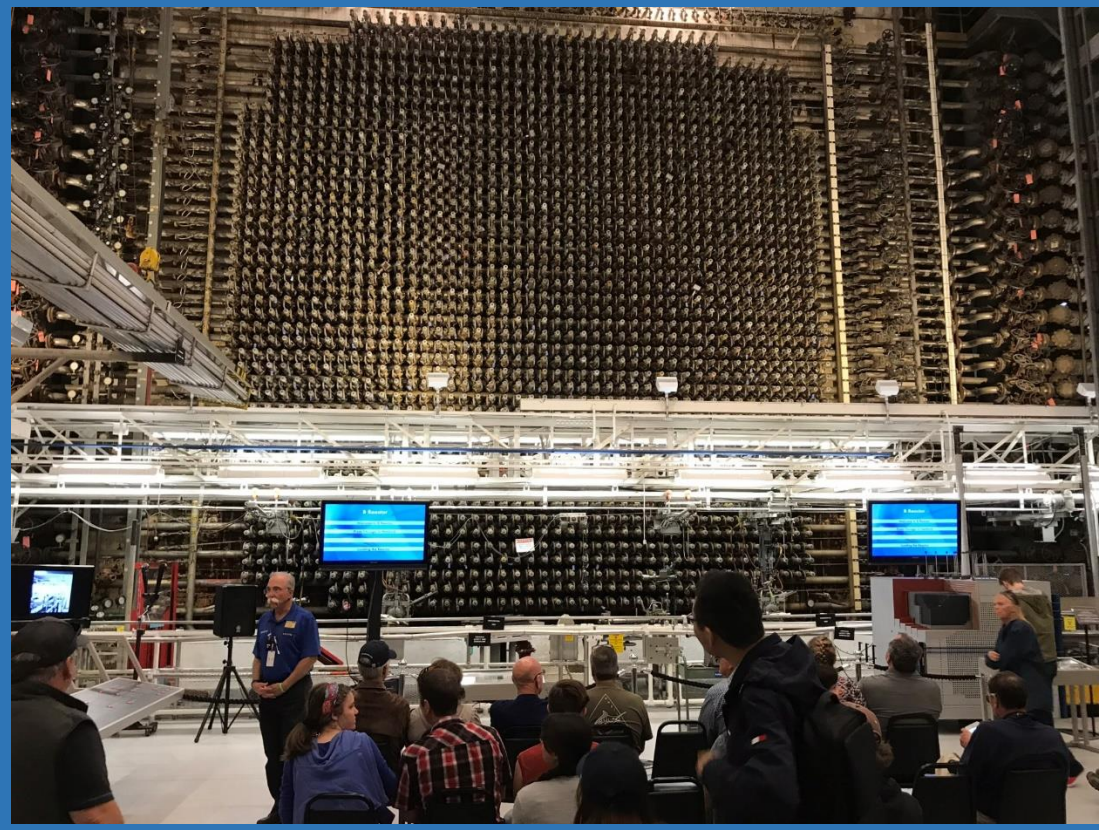
Can be dangerous if they are uncomfortable, anxious or are pressuring with "Get there-it is"

Displays can decrease workload and aid in situational awareness, however the act of programming and operating the equipment can also be a distraction.

“Seventh Inning Stretch”

4. Prevention of an Undesired Aircraft State

- An Undesired Aircraft State results from a pilot's action, or inaction, resulting in reduced a safety margin
  - An Error
- The Interplay of CRM/SRM & TEM work together to prevent an Undesired Aircraft State (UAS)
  - CRM/SRM is about managing resources
  - TEM is about managing mistakes whether external or self-induced

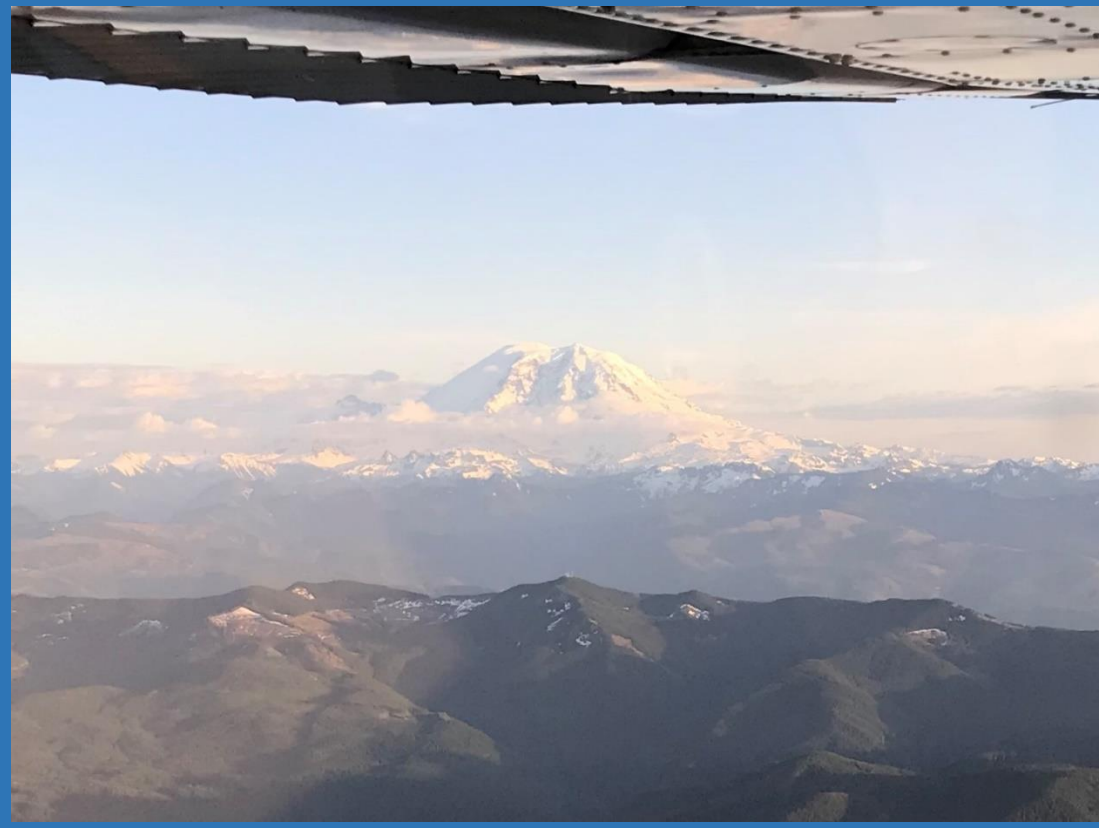


Mitigating Threats and Errors

- Threats and any resulting Errors increase the complexity of the flight
- Time &/or Action is required which increases workload.
- Increased workload is a Threat
  - The earlier the “chain” is broken by acting on the Threat, the more effectively safety can be maintained
- Without mitigation, the Threat can continue to evolve resulting in a multiplying effect of errors
  - Utilize SRM/CRM

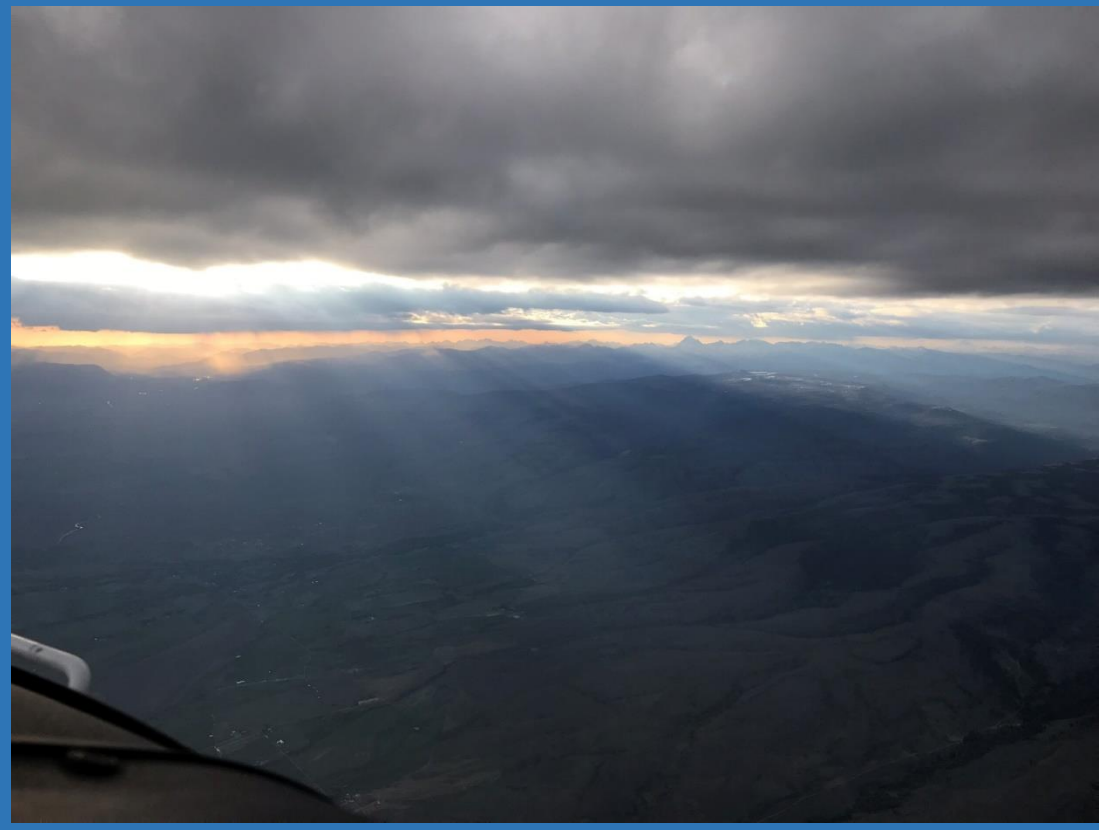
TEM: Act on Threats & Trap Errors

- Threats come at you, Errors come from you
- Act on Threats = Anticipate
- Trap Errors = Recognize
- Correction of the UAS = Recover



Examples of TEM

- You are cleared to a new Alt while distracted w/ ATIS and not sure you heard the assigned Alt correctly – this is a Threat
  - Threat: an event of situation occurring outside of the pilot's ability to influence
  - ATC is categorized as an Environmental Threat
- Act on the Threat by seeking clarification



Examples of TEM

- Initiating an IAP w/o briefing and setting up the full approach (including the missed approach) – this is an Error
  - Error: A pilot action or inaction that leads to a deviation from intentions or expectations, reduces safety margins, and increases the probability of adverse operational events on the ground or during flight
  - Inadequate IAP briefing results in two categories of Errors:
    - A/C Handling Error (improper configuration)
    - Communication Error (failure to brief either crew or yourself)
- If you land w/o incident, then no UAS
- However, if you go Missed and fail to execute the MAP properly, the result is an UAS

Examples of TEM

- Undesired A/C State (UAS)
  - Occurs when Threats are not effectively acted upon (anticipated) &/or Errors are not trapped (recognized)
  - An aircraft's position, speed, Alt, or configuration resulting from pilot error, actions, or inactions resulting in reduced Safety Margins
    - Flying an incorrect heading
    - Crossing a Hold Short line w/o an ATC clearance

Good News/Bad News

- We are the Problem and the Solution
- We often fail to recognize our own errors, overlook the errors of others and downplay Threats
- Mitigate Risks by adopting Strategies and Countermeasures through Training and Practicing TEM

Threat & Error Management Approach

- Anticipation (a strategy)
  - Understanding that something is likely to go wrong, therefore be vigilant in looking for something out of place
  - Discipline yourself to always be on guard
- Recognizing a Problem (a countermeasure)
  - Identify the source
- Recovery (a countermeasure)
  - Correct the situation before it leads to an error or UAS

Threat & Error Management Approach

- Utilize Strategies and Countermeasures to prevent Threats from becoming Errors, and Errors from compounding
  - Technology
  - Briefings
  - Checklists (mnemonics) and consistent procedures

Threat & Error Management Approach

- Strategies and Countermeasures
  - Technology can enhance situational awareness both on the ground and en route
    - Can also be a distraction, if not operating properly or is new, which is a Threat
  - We can brief ourselves (preflight Wx briefing through flight planning programs or a Briefer
    - A Briefer is still useful when the online material is unclear
    - Include your copilot pax
  - Checklists (mnemonics) and consistent procedures (Flows) are SOP that result in safeguards which make you more reliable when tired, distracted, or dealing with the unexpected

Threat & Error Management Approach

- PIC responsibility is to mitigate risk and manage safety
  - Models such as PAVE are a starting point
    - Personal
    - Aircraft
    - EnVironment
    - External Pressures

Summary

- Threats come at you, Errors come from you
- Errors do not always arise from Threats
- Threats, if properly managed, do not always lead to Errors
- Mitigate Risks by adopting Strategies and Countermeasures through Training and Practicing TEM
- Utilize SRM/CRM in TEM to prevent UAS
- Practice/Time/Experience mitigates Time Pressured Decision-Making
- Risk MUST constantly be Assessed and Managed

Thank You!