Workshop on Piloting Techniques

Kathmandu

29 – 30 August, 2024

Presenter

Wg. Cdr. B. S. Singh Deo (Retd.)

Vice President

Rotary Wing Society of India

Presenters Bio

- Former IAF helicopter pilot, Instructor and Test Pilot
- Commercial helicopter pilot, Ops, Trg & Safety Manager
- Technical Pilot in Malaysian Helicopter Service
- Former MD of Bell Helicopter (South Asia)
- 8,000 flight hours in 5 types of aeroplanes and 14 types of helicopters

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ROTARY WING SOCIETY OF INDIA

- Established in 1998
- 1,257 Life Members
- 184 Corporate Members
- 15 Associate Members
- Drone Group – 7 Members
- Patrons: Army, Navy & Air Force Chiefs, Ratan Tata and Vijaypat Singhania

Affiliations:

- Aeronautical Society of India
- Helicopter Association International (Now VAI)
- American Helicopter Society (Now VFS)
- Founding Member of International Federation of Helicopter Associations(IFHA) (observer Status in ICAO)
- International Helicopter Safety Foundation (Regulatory Member of the Council)
- Founding member of **VAST** (successor of IHST)
- HAI’s International Partnership Program

Helicopter Association International

Certificate of Recognition

Presented to

ROTARY WING SOCIETY OF INDIA

In celebration of 20 years of contributions to the
Indian helicopter industry by promoting safety through education

September 7, 2018

Matthew S. Zuccaro
HAI President and CEO

James O. Wisecup
HAI Chairman of the Board

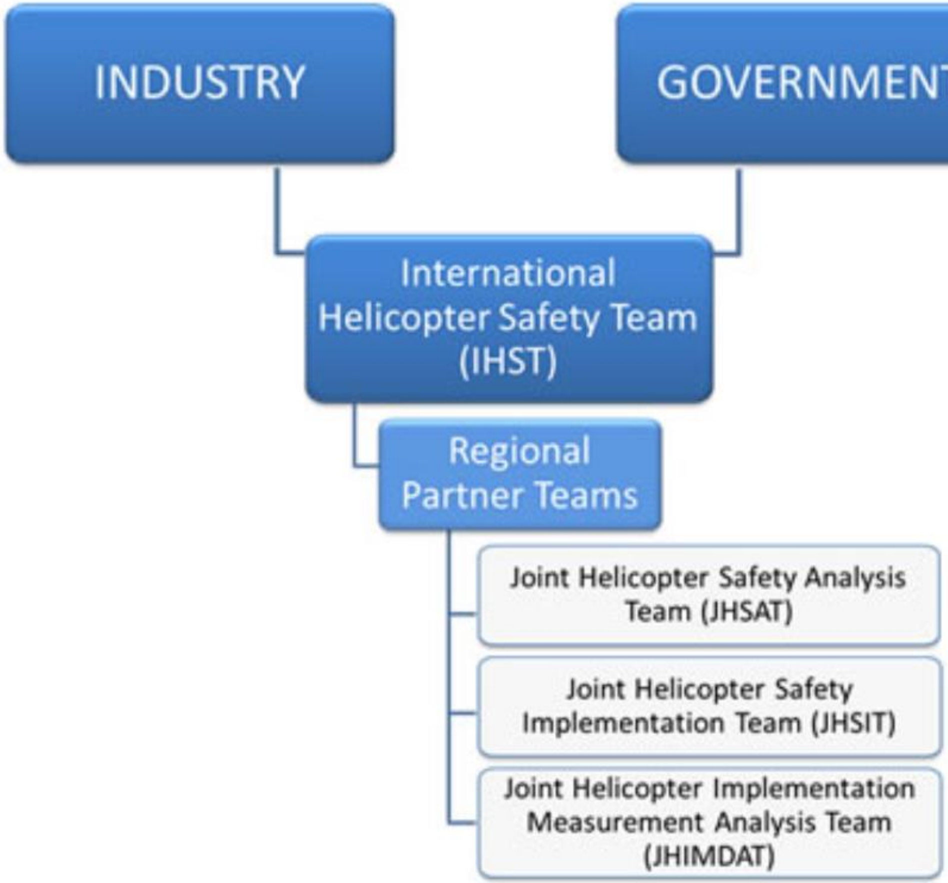
Training Course during VERTICOM 2025 in Dallas, March 2025 – RWSI wins a contract

From: **Gregory Brown** <gregb@verticalavi.org>
Date: Tue, 6 Aug 2024 at 01:22
Subject: ELEVATIONS (PEC) SELECTION
To: president.rwsi@gmail.com <president.rwsi@gmail.com>

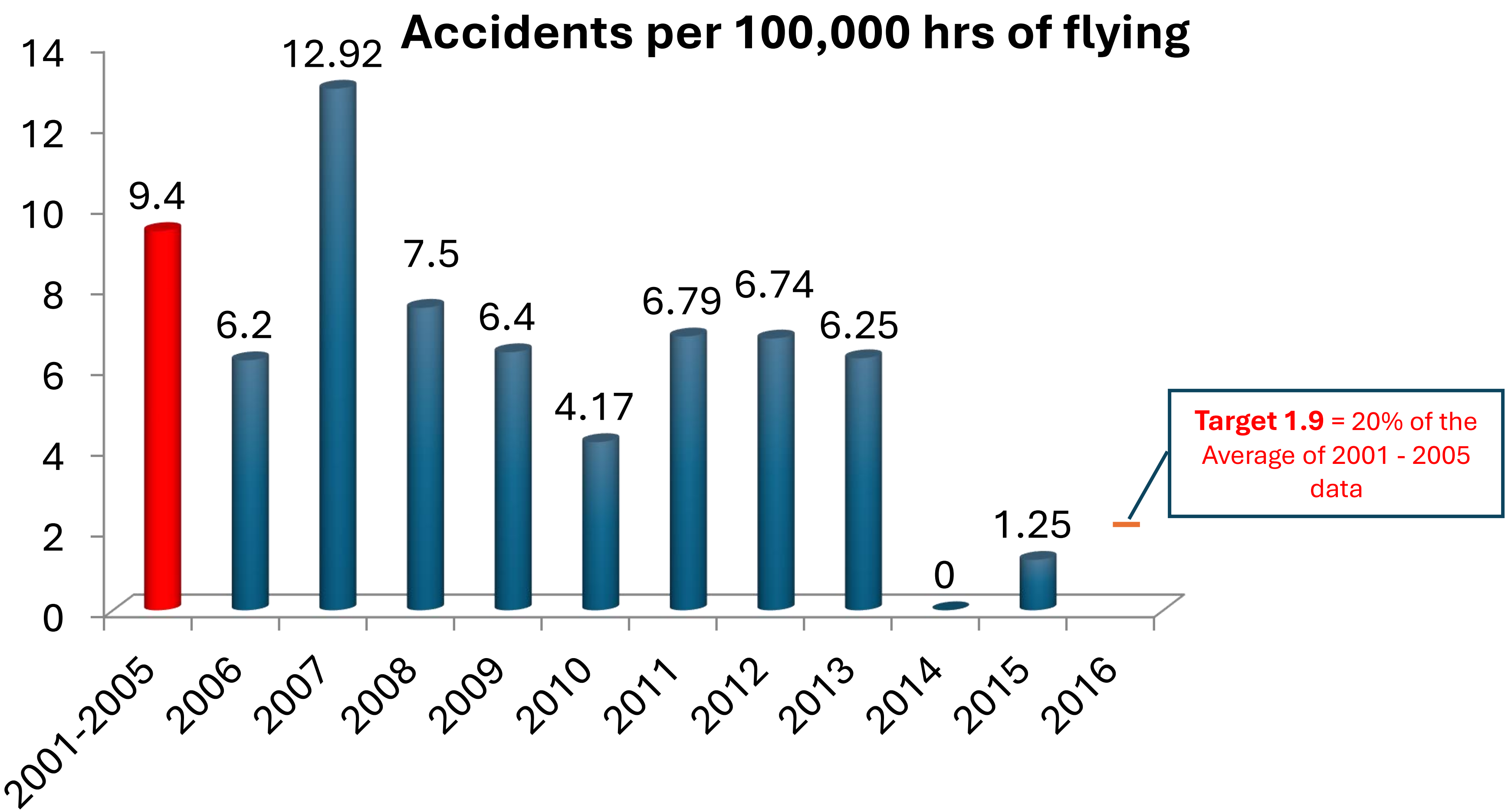
Hello Air Marshall
I wanted to let you know that your submission, Advanced Helicopter Operations: Mastering Safety and Operational Efficiency was selected for VERTICON 2025 course line up. I will contact you with additional information and a contract to review and sign. In the meantime, please reach out with any questions

Greg Brown
Director of Education and Training
Direct Line: 703-302-8479

IHST


INDUSTRY
GOVERNMENT
International Helicopter Safety Team (IHST)
Regional Partner Teams
Joint Helicopter Safety Analysis Team (JHSAT)
Joint Helicopter Safety Implementation Team (JHSIT)
Joint Helicopter Implementation Measurement Analysis Team (JHIMDAT)

Civil Helicopter Accident Rate Trend in India



* Data Courtesy RWSI

https://vast.aero/

www.rwsi.org

https://ihsf.aero/

aviation-safety.net/dashboard/heliplus

Workshop Schedule

29th August

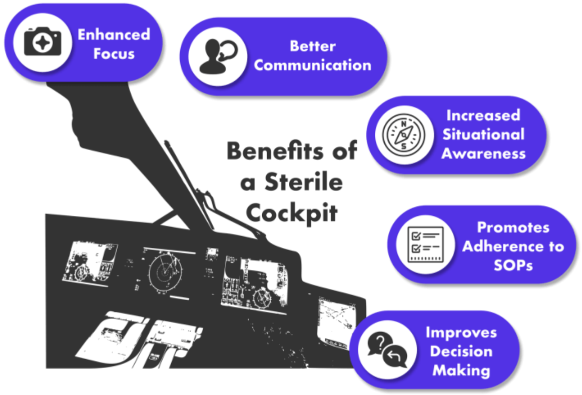
- Introduction
- Sterile Cockpit & Operational Briefing
- Mountain Operations

30th August

- Human Factors
- Safety concepts and CFIT
- Safety Culture
- Avoidance of Helicopter Wire Strikes
- Back to Basics (Helicopters)

DAY 1

Sterile Cockpit Concept



Operations Briefing

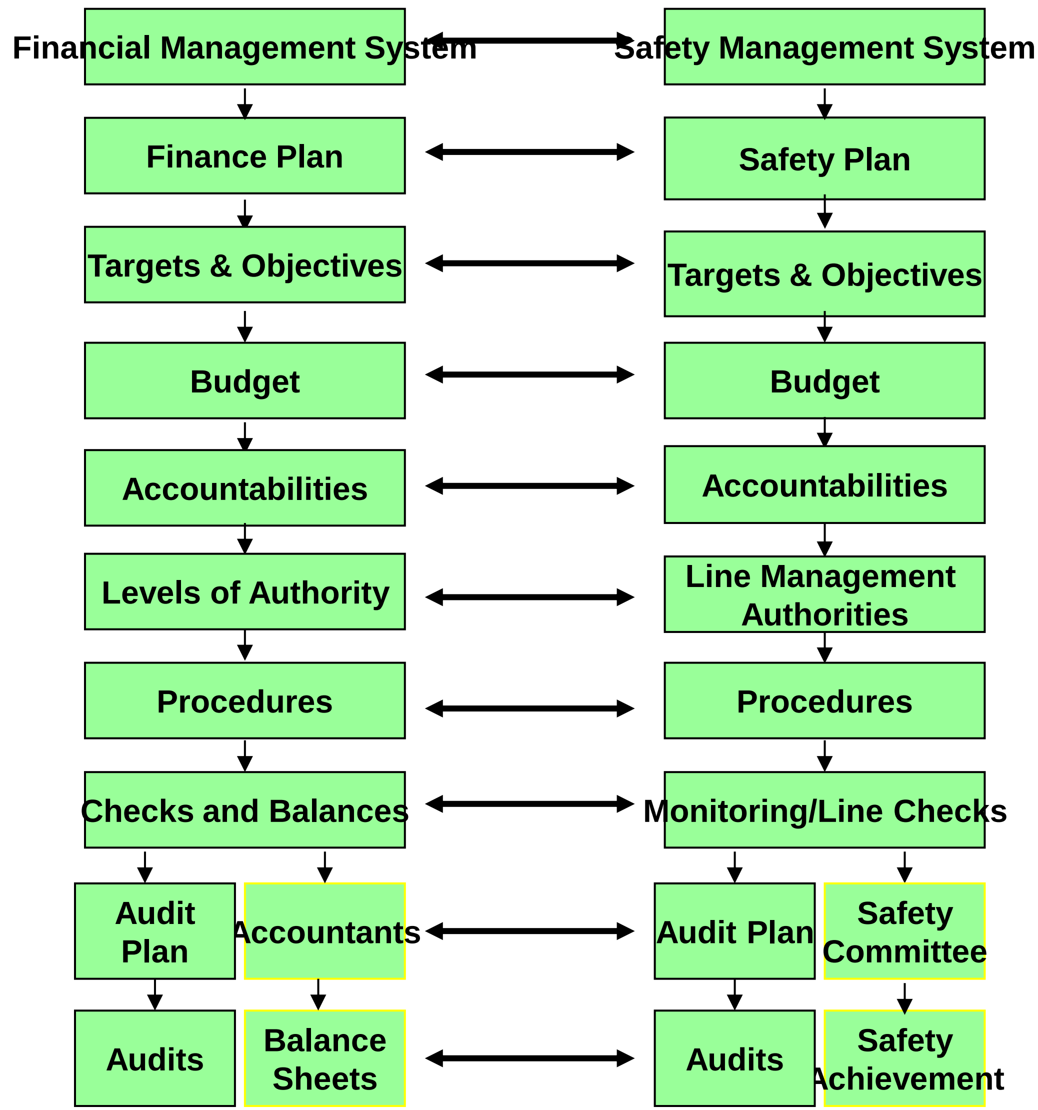
Briefings are complementary to SOPs ....

DAY 1

Mountain Operations

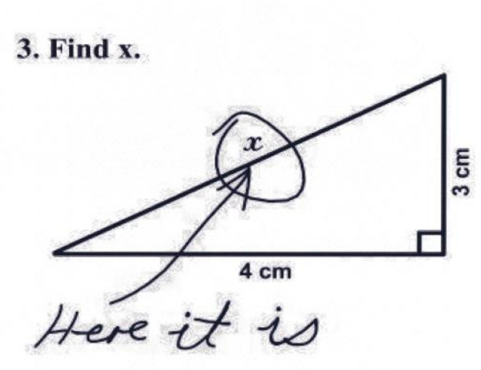
DAY 2

Safety Concepts & CFIT



DAY 2

Human Factors

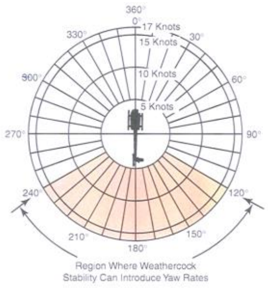


DAY 2 - Avoidance of Helicopter Wire Strikes

DAY 2 – Back to Basics

VORTEX RING STATE

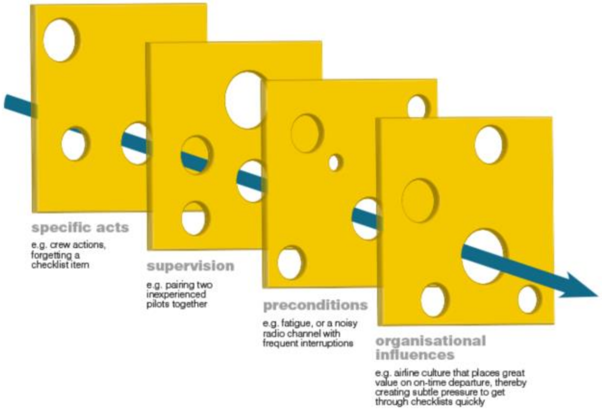
LTE - Loss of Tail Rotor Effectiveness



DYNAMIC ROLLOVER

DAY 2

Safety Culture



“CULTURE EATS STRATEGY FOR BREAKFAST”

Interactive sessions are encouraged

Ask questions whenever in doubt

Take notes for Action Plans

THANK YOU

The Sterile Cockpit Concept:

When Focus is a Choice

Wg. Cdr. B. S. Singh Deo, VM (Retd.)

Kathmandu, 29 August, 2024

Imagine this: We’re on the jump seat in the cockpit of Eastern Airlines Flight 212 from Charleston to Charlotte, USA ✈️
During the final stage of the flight, we can hear the pilots talk about all sorts of things like buying cars, trying to spot a local amusement park, the stock market, and the economic recession.
Flaps 50 is selected at a speed way above the limit, but neither the Captain nor the FO seems to pick this up ❌
We’re about 450 feet too low during the approach, and we’re only 624 feet above the runway elevation.
Yet still, the cockpit atmosphere is super casual and laid back 🥱
Moments later, the pilot flying increases the descent rate from 300 to 800 feet per minute, with 5 nm to go…
We now descend THROUGH the MDA without any standard calls being made, into ground fog ☁️
At this point, the pilots complete the before landing checks, and the captain says: “Yeah, we’re all ready, all we got to do is find the airport”.
Seconds later, the FO shouts in panic as he spots the ground through the fog. The plane hits the ground and crashes into a forest, where most of the plane goes up in flames 🔥
Of the 82 people on board, 72 died…
Pretty terrifying stuff right? Well, the NTSB and the FAA agreed. This accident led to the adoption of the sterile cockpit concept in 1981.
Nope, nothing to do with clean cockpit screens. Let’s talk about what it actually means ⤵️

Sterile Cockpit

What is a Sterile Cockpit?

Originally designed by the FAA in 1981. Aim was to reduce accidents caused by <u>distractions</u> and <u>interruptions.</u>

<u>FAR 121.542</u>:

- *<u>"No certificate holder shall require, nor may any flight crew member perform, any duties during a critical phase of flight except those duties required for the safe operation of the aircraft."</u>*

- *<u>"No flight crewmember may engage in, nor may any pilot in command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties."</u>*

In Europe as well, same rules as the FAA:

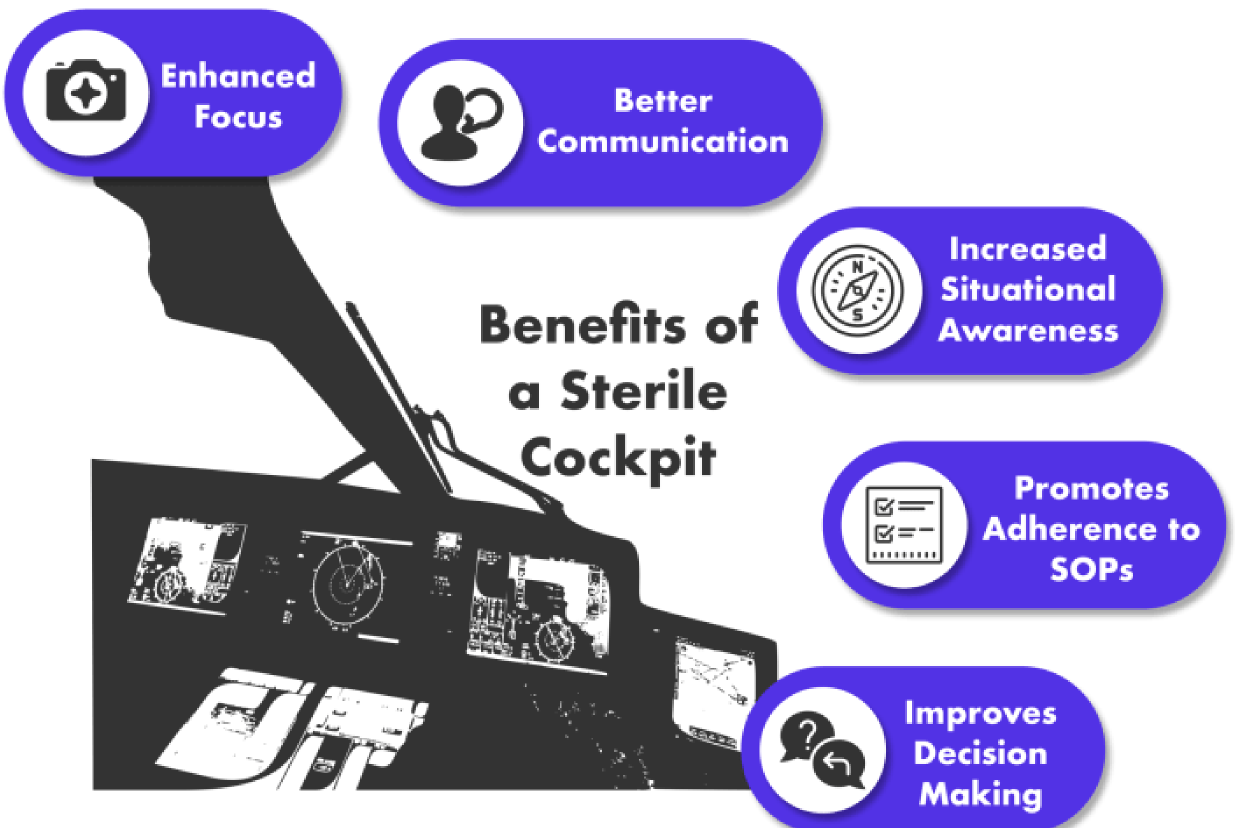
“The commander shall not permit any crew member to perform any activity during take-off, initial climb, final approach and landing except those duties required for the safe operation of the aeroplane”

Basically, don’t talk about recessions, cars, or anything else that’s not relevant to flight safety while you’re on an approach or in any other safety critical phase 🛬
Many operators have slightly more strict rules on this, like considering the ‘sterile’ zone anything below 18,000 feet.

For helicopters, these criteria are often more specific due to the nature of various helicicopter operations.
For HEMS in the UK for instance, most manuals dictate a sterile cockpit:
•below 300 feet during the day 🌞
•below 500 feet during night time 🌙
These can be more strict, depending on your location and operator. If you’re unsure, check your OPS manual ✅

The 5 Benefits of a Sterile Cockpit

Sterile Cockpit concept is to improve overall flight safety, and help crews with problems they might encounter during critical phases, but in what ways? 💡



1) Enhanced Focus

Less pointless chatter = less distraction = improved focus ⬆️
It's all well and good to have a great vibe between crew members, but the burden of it can show when you're trying to concentrate and the other crew member is distracting you with pointless conversation.
Of course there is a balance here, which we'll cover later.

2) Better Communication

One of the main benefits of having no conversations that benefit flight during those critical phases, is that anything that does get raised can be assumed to be immediately relevant.
This makes communication more straight forward, and helps to reduce barriers for you to speak up about things that actually require challenging or attention 🧠

3) Increased Situational Awareness

Having a shared mental model with other crew members is one of the main requirements to work together effectively and to be aware of your surroundings.
If you have different perceptions of reality that don't really match, it's much easier to end up as part of the accident statistics 📊

4) Promotes Adherence to SOPs

The promotion of a sterile cockpit, whether through a pre-flight briefing, company training, or discussions amongst pilots within companies, encourages adherence to SOPs.
If having a sterile cockpit becomes one of those things that is part of the 'this is how we do things here' list, it becomes much easier to actually make those standard calls, and check the things you're supposed to check 👀

5) Improves Decision Making

Timely and effective decision making is only possible by having the things mentioned above. Adherence to SOPs, situational awareness, focus, and effective communication are all directly linked to crews that make good decisions 💡
Decisions are only as good as the data that is used to make them. This data will be of much higher quality if non-relevant conversations aren't in the way.

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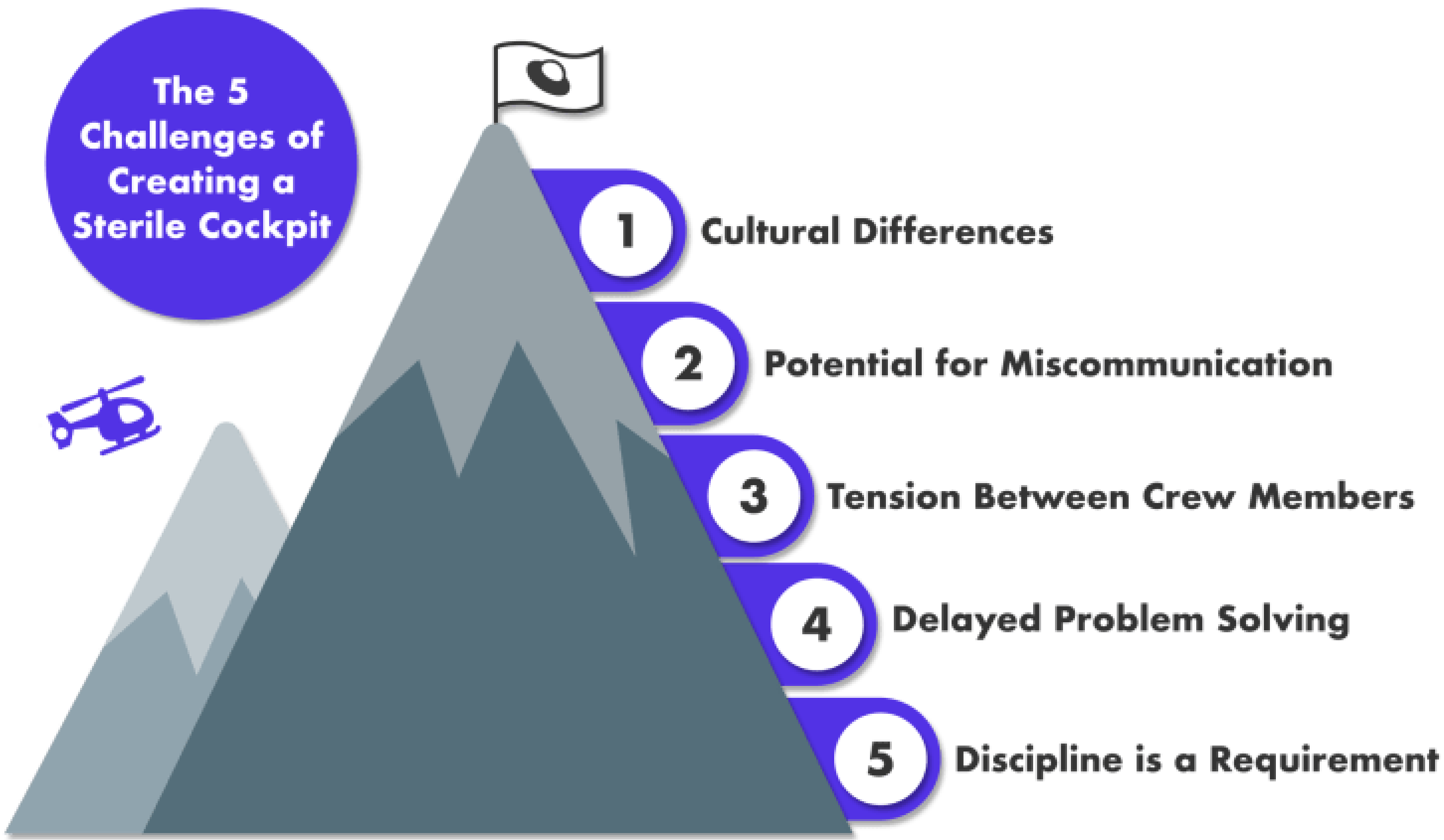
The 5 Challenges of Creating a Sterile Cockpit

Here are the biggest hurdles:



The 5 Challenges of Creating a Sterile Cockpit

1) Cultural Differences

While regulation is pretty static, people often have weird opinions of those regulations. Depending on which part of the world you're in, what company you fly for, and who the crew is that you'll be flying with, you might find it difficult to convince others that having a sterile cockpit is important. This is especially true where you fly with the same people often, and relationships between crew members are very informal'. Having time for humour and jokes is fine, but a line needs to be drawn somewhere.

2) Potential for Miscommunication

Set clear boundaries and expectations to eliminate potential for miscommunication. What is considered 'critical' information, and what isn't?

The 5 Challenges of Creating a Sterile Cockpit

3) Tension Between Crew Members

Disagreement on what is ‘safety relevant’ will lead to tension between crew members.

If someone feels discouraged to speak about things that they deem important, you’ll get a reduction in communication. This is contrary to concept of sterile cockpit and must be managed carefully.

This is especially true in settings where crew members in the cabin are not necessarily part of the aviation culture we are all used to (like in HEMS or air ambulance).

4) Delayed Problem Solving

The items mentioned above reduce the effectiveness of a team.

Solving problems is how we as pilots make sure that flight safety levels do not go down when sh** hits the fan 💩

If crucial information is not being raised, or if crew members feel like they can’t speak up or challenge you, you simply won’t be aware of information you haven’t seen yourself. Not a good thing. Which is why this requires training, awareness, and briefing if it’s not clear.

The 5 Challenges of Creating a Sterile Cockpit

5) Discipline is Required

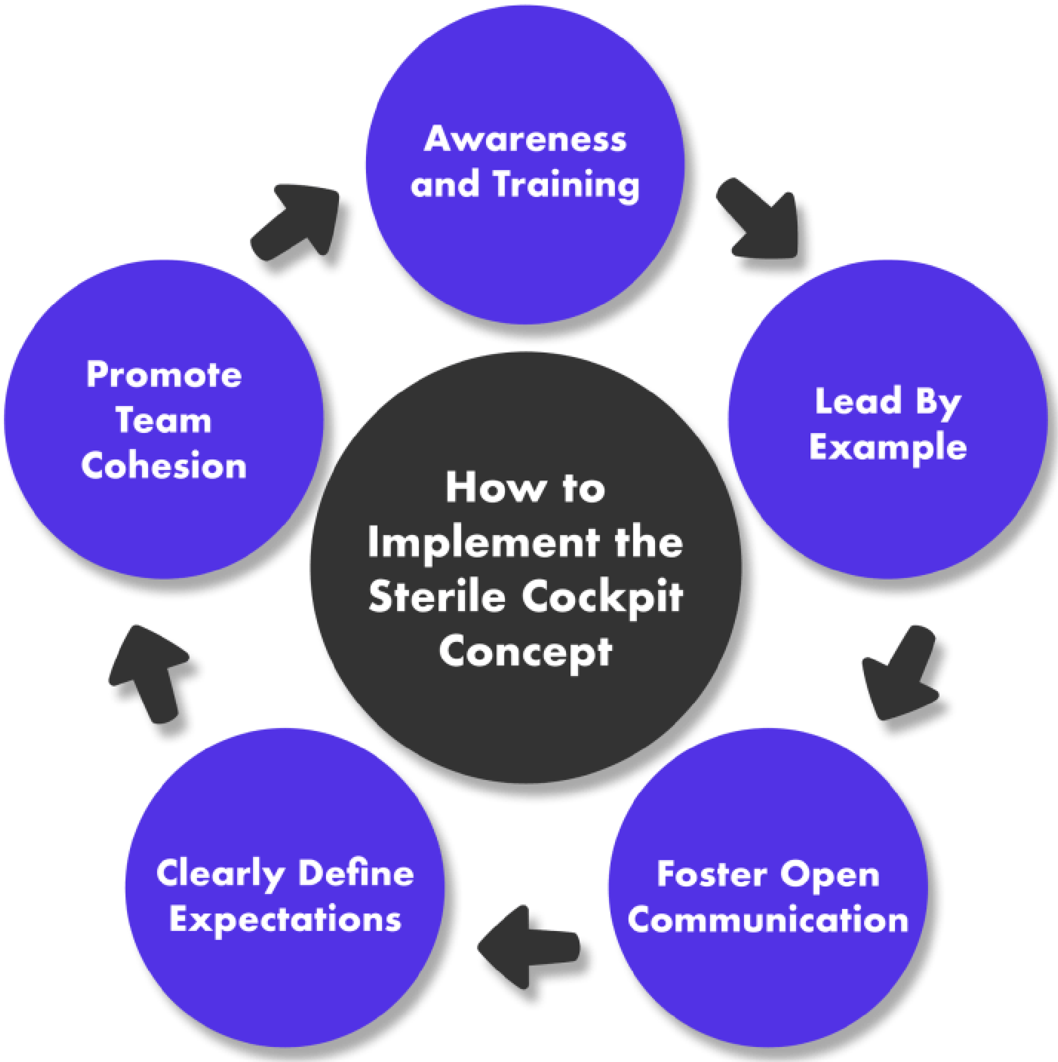
And then there's the elephant in the room: Complaining (or simply talking) about your home situation, your pay, the economy, your annoying neighbour, or that unfriendly man in HR, is a way of coping with stress for many people

This is where discipline comes in. There's a place and a time for everything. You might be surrounded by people who think it's ok to talk about that stuff during the approach phase. And even if they don't think it's ok, they might do it anyway.

It requires professionalism and a healthy balance of discipline to draw the line somewhere. Where is your company's line, and how does it compare to yours?

Implementing the Sterile Cockpit Concept

Here are 5 great things to start with ⤵️



Implementing the Sterile Cockpit Concept

1. Awareness and Training

In aviation, it all starts with awareness and training. If there is lack of awareness, start training. If everyone is aware already, but there's no training or notes in the OPS manual, put some SOP's in place.
Only through reinforcing good habits, and discouraging bad ones through line training, briefings, and conversations can you get to a stage where it's ingrained in a company culture.

2. Lead By Example

Don't expect others to adhere to anything if you're not leading by example yourself. If you don't think it's appropriate to talk about a specific topic during a critical phase, don't start any, and clearly communicate your views if someone else does.

3. Foster Open Communication

Make sure people can openly say things that need saying and feel like they can challenge you. While at the same time making sure conversations are relevant and concise during critical phases of flight.

Implementing the Sterile Cockpit Concept

4. Clearly Define Expectations

If your colleagues are too relaxed about having a sterile cockpit, openly communicate this in either the brief or debrief 📋

If you're flying with non-pilots, this is even more important, as it might not be obvious to those individuals that this is an expectation / SOP.

5. Promote Team Cohesion

As mentioned earlier, there's a time and a place for fun. Being too strict and serious about every little thing does not help team cohesion. Instead, it can be helpful to take the opportunities to have some silliness when the situation allows for it, and when it's appropriate. Having a good relationship and bond with your crew helps with working together when things get tough, whether that's during the approach or before even stepping into the aircraft.

Conclusion

Having a sterile cockpit rule isn’t just about quieting down the cockpit.

It’s about enhancing focus and ensuring safety during critical flight phases.

It aims to reduce distractions and maintain clear, relevant communication when it really matters.

There’s a way to go overboard with this, and finding a balance between professionalism and companionship is important to keep the most important thing at number 1: Flight safety.

THANKS

OPERATIONAL BRIEFINGS

Wg. Cdr. B. S. Singh Deo, VM (Retd.)

Kathmandu, 29 August, 2024

What is a Briefing?

- Briefings are an integral element of the Threat and Error Management process. Focus on identifying threats and develop mitigation strategies.
- Identification of significant differences or deviations to "routine" operations. At the end of the briefing, the crew should have a “shared mental model” of the intended operations, the identified threats, their mitigations and deviations from routine operations.
- The briefings should provide the Pilot Monitoring (PM) the expected monitoring framework and should create more capacity in thinking and acting. It enables team building and minimize the “startle effect” when non-standard situations arise. This increases resilience of the crew.
- Briefings are complementary to SOPs but are <u>not a repetition</u> of SOP items. They are not to be confused with setting and checking of the aircraft systems for the intended flight phase. For such tasks, the crew must follow the SOPs.

GENERAL BRIEFING TECHNIQUE

- Requires out-of-the-box thinking, beyond routine and standard operations. It should have a threat-focused view and identify and prioritize likely threats to the intended operation. It should then detail the actions to mitigate these threats. Sources of the briefing are the facts gained in the flight crew pre-flight preparation, aircraft operation, and also the overall knowledge and experience of all involved flight crewmembers.

- A briefing should be interactive, involving open questions that involve all flight crewmembers to share their experience and expectations.

- There should be a variation in the level of detail and in the length of a briefing. A longer, more detailed briefing may be necessary in situations such as:

  1. Crew operating to an unfamiliar airport or executing an unfamillar approach.
  2. Complex airport.
  3. Procedures or techniques that are rarely flown or applied.

GENERAL BRIEFING TECHNIQUE (Contd.)

For most other times, a more concise briefing restricted to the minimum items is possible. For example:

- Operating at a familiar airport
- Repetitive operations by the same crew
- No or limited threats Identified
- A long briefing is not necessarily a good one.
- A review of **Memory Items** or **Operating Techniques** should normally be part of the briefing when potentially required for threat management (e.g. windshear reported in ATIS - a review of Windshear Escape Maneuver).
- A briefing of the techniques for rejected takeoff and/or for engine failure after V1 is normally NOT required on a routine basis for each takeoff.

THREATS

Threats are all of the following:

- Events or errors that occur beyond the influence of the flight crew
- Increased operational complexity
- Situations that must be managed to maintain the margin of safety.
- There is no limit to the possible number of threats that may occur.
- Using a checklist-style tool to identify threats creates an obstruction to the open-mind setting and out-of-the-box consideration. To help with threat identification, memory aids may be of help, provided that they are not used in a checklist style manner.

TYPES OF OPERATIONAL BRIEFING - GENERAL

The following operational briefings could be performed for each flight:

- **DEPARTURE BRIEFING** during cockpit preparation.

- **ARRIVAL BRIEFING** during descent preparation.

- **CRUISE BRIEFING** on reaching cruising level when the crew expects specific operational threats (e.g. high terrain, weather) or before the aircraft enters areas with special operational rules.

- **A Post Flight Review** should be at the end of each flight. This allows a review of how the plan and the management of expected and unexpected threats and errors worked. This makes it possible to enhance handling of future similar scenarios. It is a powerful tool for long-term safety management.

- **Re-Briefing / Mini Briefs** - in the case of any newly identified threats or changes to the planned flight strategy (e.g. when a Departure Change is applied. Also in case of major delay since the Briefing was performed or in case of a major deviation from the original flight plan).

PREPARATION FOR BRIEFING

Preparation for every briefing starts with the preparation for the flight mission. Preparation continues throughout the dispatch flight preparation with the collection of data on all of the following:

- Technical condition of the aircraft

- Route planning

- Weather

- NOTAM

- Load planning

- Company operational requirements

- Fuel planning.

ESSENCE OF BRIEFING

1. Emphasizes more on **“probable”** events such as runway changes or an overweight landing, rather than the serious, but **less likely** emergencies like Engine Flameouts, etc.

2. Reduces verbiage keeping it concise and more relevant.

3. Leaves room for “mini-briefs” - useful in a crucial phase of flight in an evolving environment that involves higher workload.

MINI-BRIEFS COULD SAVE THE DAY

CONCLUSION

Flight preparation is done partly independently by PF and PM, partly shared by both pilots. At the aircraft, the following parts of the SOP contain items to be discussed and agreed by both pilots:

- Aircraft acceptance

- Preliminary performance calculation

- Last part of cockpit preparation after FMS preparation by the PF.

These SOP items are intended to prepare a shared mental image by both pilots. They ensure that the following operational briefings are concise, effective and focus only on essential items.

HELICOPTER MOUNTAIN OPERATIONS

29 August, 2024

Wg Cdr B S SINGH DEO, VM

VICE PRESIDENT, RWSI

Capt Rameshwar Thapa
President, Helicopter Society of Nepal

Look forward to HSN and RWSI working together

HELICOPTER MOUNTAIN OPERATIONS

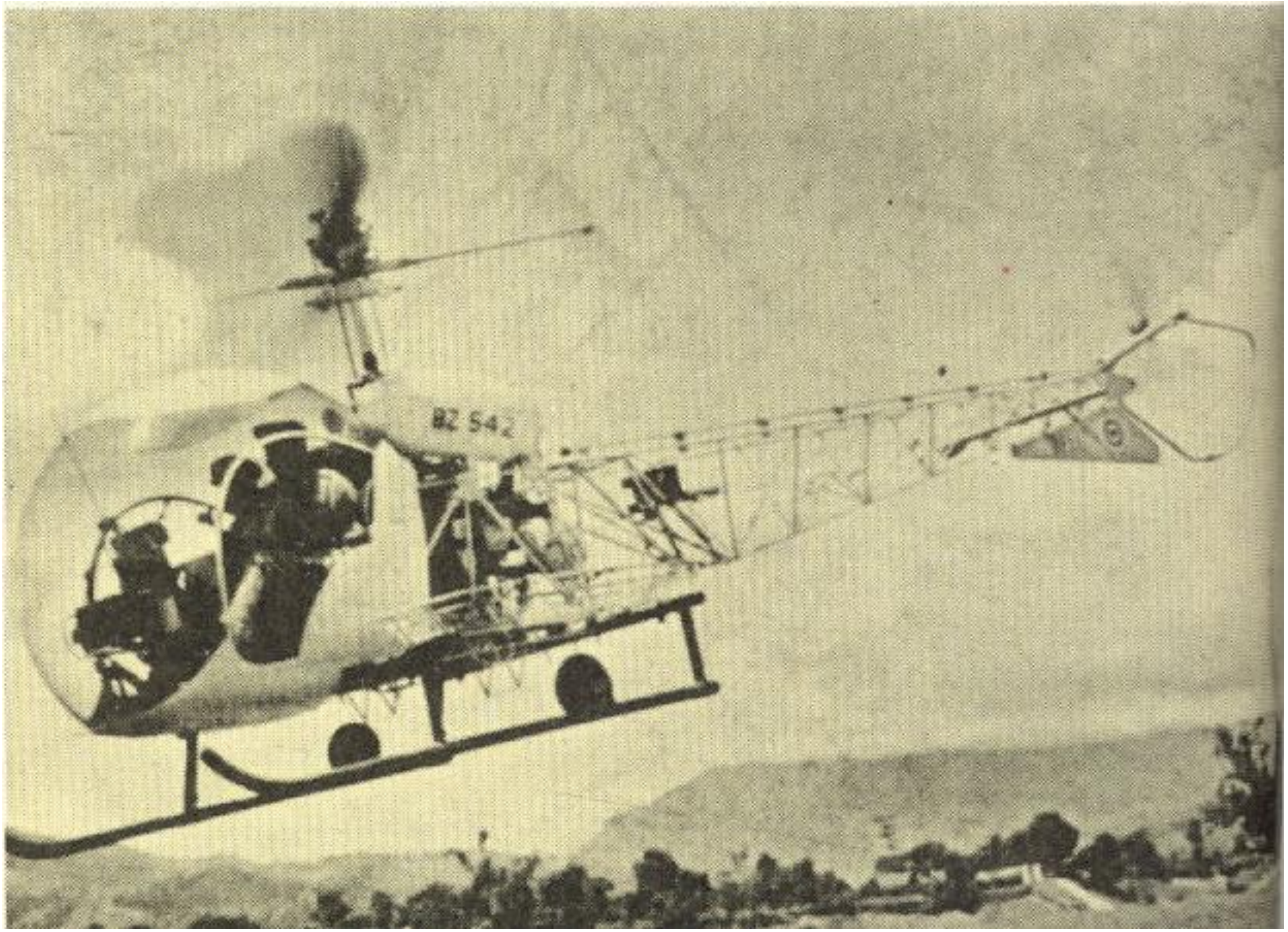
ARTISTS VIEW

TOURIST'S VIEW

DISASTER VICTIMS' VIEW

GAURIKUND 'HELIPAD'

HISTORY OF MOUNTAIN OPS IN NEPAL



Bell-47 from Ostermans Aero of Sweden flew the two Everesters in Nepal in 1953

Nepal saga of Bell-47

Known as **firr-firre** in Nepali, it was stationed in Singha Durbar. “It normally took-off from the Putali Bagaicha early morning, hovering up much like a dragonfly…” …..**July 1964 – Feb 1965**

Elmer Munsell likely pilot?

https://myrepublica.nagariknetwork.com/news/nepal-saga-of-bell-47

Near JOMSOM – 23,000 ft. Density Altitude

WHAT IS MOUNTAIN FLYING?

- **Definition can me misleading. Must understand the *factors***
- **‘Mountain’ conditions can be experienced even at sea level:**
  - High Gross Weight
  - High Ambient Temperature leading to High Density Altitude
    - Flare Heat over Helideck
    - Surface heating causing high ambient temperature
  - Terrain
  - Localised Weather

Importance of Density Altitude

“Ingenuity” flight in Mars surface was like 100,000 ft Density Altitude on Earth. (Feb 2021)

Localised Weather

COMPLIANCE WITH CAR SERIES ‘H’ PART II

- Initial CRM training completed for PIC (Para 3.5)
- Annual Training on Emergency Duties for all Crew Members (Para 3.6)
- Current with DGCA Approved Ground & Flying Trg (Para3.7)
- Trg. on Procedures specific to operating environment (3.7.4)
- Currency – PIC & Co-pilot carried out 3 Take Offs & Landings on Helicopter Type or Simulator in preceding 90 days (Para 3.8)
- Current with Annual Line Check (Para 9.2.3)

COMPLIANCE WITH CAR SERIES 'H' PART II (Contd.)

- Night Flying Check and Night Route Check (Para 9.2.5) *(In case return flight to base is delayed.)*
- All operations shall be under VFR or Special VFR (if within control zone), except when following an established Instrument Procedure at a designated airport/heliport in such terrain.
- If not current with Hill/Mountain Flying in the last 12 months, fly a Hill Ops **training** sortie of 0:45 hr followed by **Check** sortie of 0:45 hr with a TRE/TRI to regain currency. (11.1.5.1)

COMPLIANCE WITH CAR SERIES 'H' PART II – GROUND TRAINING

11.1.4 Ground Training. The ground training specific to hill/mountain operations, where applicable, shall be conducted for a duration of at least 4 hours at a DGCA approved GTO/ATO or by a TRE/TRI/Check Pilot/Chief Pilot as follows:

11.1.4.1 Density altitude and performance consideration.

11.1.4.2 Effects of decreased air density on engine and airframe.

11.1.4.3 Type performance – Rotorcraft Flight Manual.

11.1.4.4 Physiological Effects - Lack of oxygen and external horizon.

11.1.4.5 Mountain winds - Convection and air mass stability, wind pattern across prominent features of rounded shape and sharp contours, standing waves, rotor streaming turbulence, ridges, conical hills and valleys.

COMPLIANCE WITH CAR SERIES 'H' PART II – GROUND TRAINING (Contd)

11.1.4.6 Transit flying - Pre-flight planning, blade stall, engine failure, wind assessment enroute.

11.1.4.7 Actions when caught in a down draught, ridge crossing and valley flying.

11.1.4.8 Wind assessment.

11.1.4.9 Meteorological peculiarities of the area of operations and its effect on helicopter operations.

11.1.4.10 Winter operations including Helicopter Icing.

11.1.4.11 High altitude operations and effects on helicopter performance.

CAAN Syllabus (FOS-10-12)

- Humidity and Precipitation
- Humidity in atmosphere and its effect on density
- Humidity variation and weather associated with it
- Condensation, precipitation, sublimation and freezing in atmosphere
- Precipitation, its characteristics and development.

MOUNTAIN FLYING

Factors:

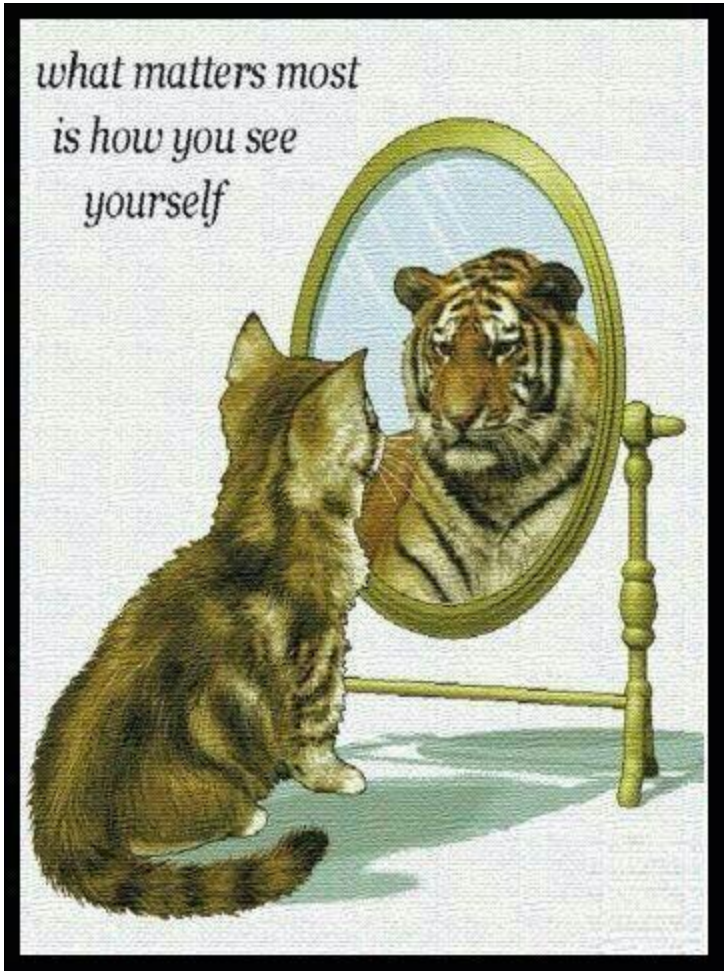
- Altitude & Temperature Effects
- Aerodynamic Factors
- Terrain
- Meteorology and Weather Issues
- Aeromedical issues
- Human Factors

WHY MOUNTAIN OPERATIONS NEED SPECIAL SKILLS

- Helicopter **performance degradation** due High DA
- CREW/PAX **Oxygen** requirements
- More severe/changeable **local weather**
- **Heliports** may not be as developed
- Suitable **precautionary landing** spots are less available
- **Survival** in an off-airport landing
- Flight **hazards**
- **Meticulous** preflight planning is necessary

There is no substitute for Training and Experience

MOUNTAIN OPERATIONS NEED CORRECT **ATTITUDE**



OVERCONFIDENCE IS A **NO NO**

ATMOSPHERE & EFFECT OF ALTITUDE

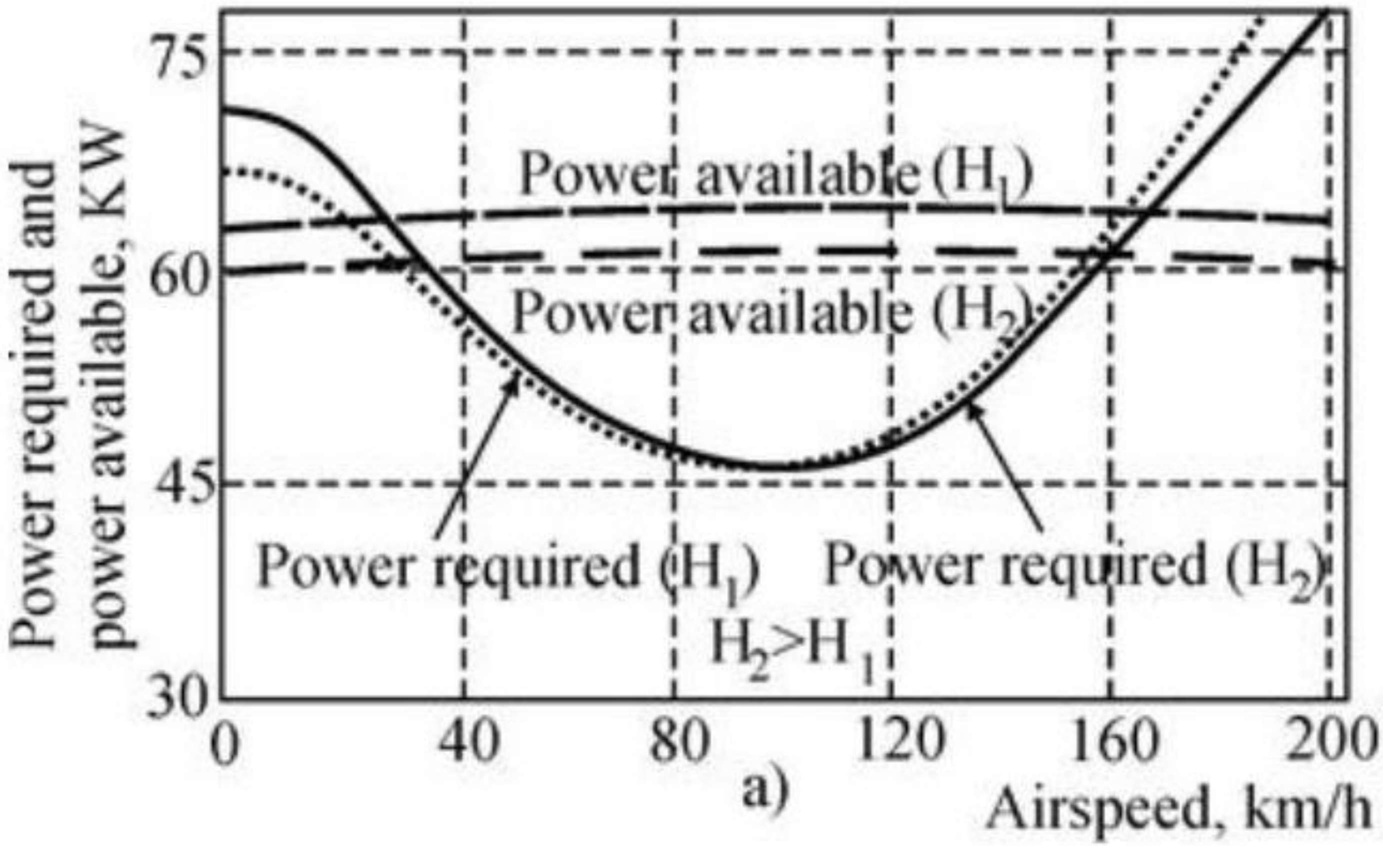
Composition

- 21% Oxygen, 78% Nitrogen
- 0 - 5% water vapour – causes many complications
- OEMs assume 80% RH. Expect 3 – 4 % power loss compared to dry air)

Tips:

- Temperature decreases 2 ^{0}C per 1,000 ft
- Density decreases 2.5% per 1,000 ft

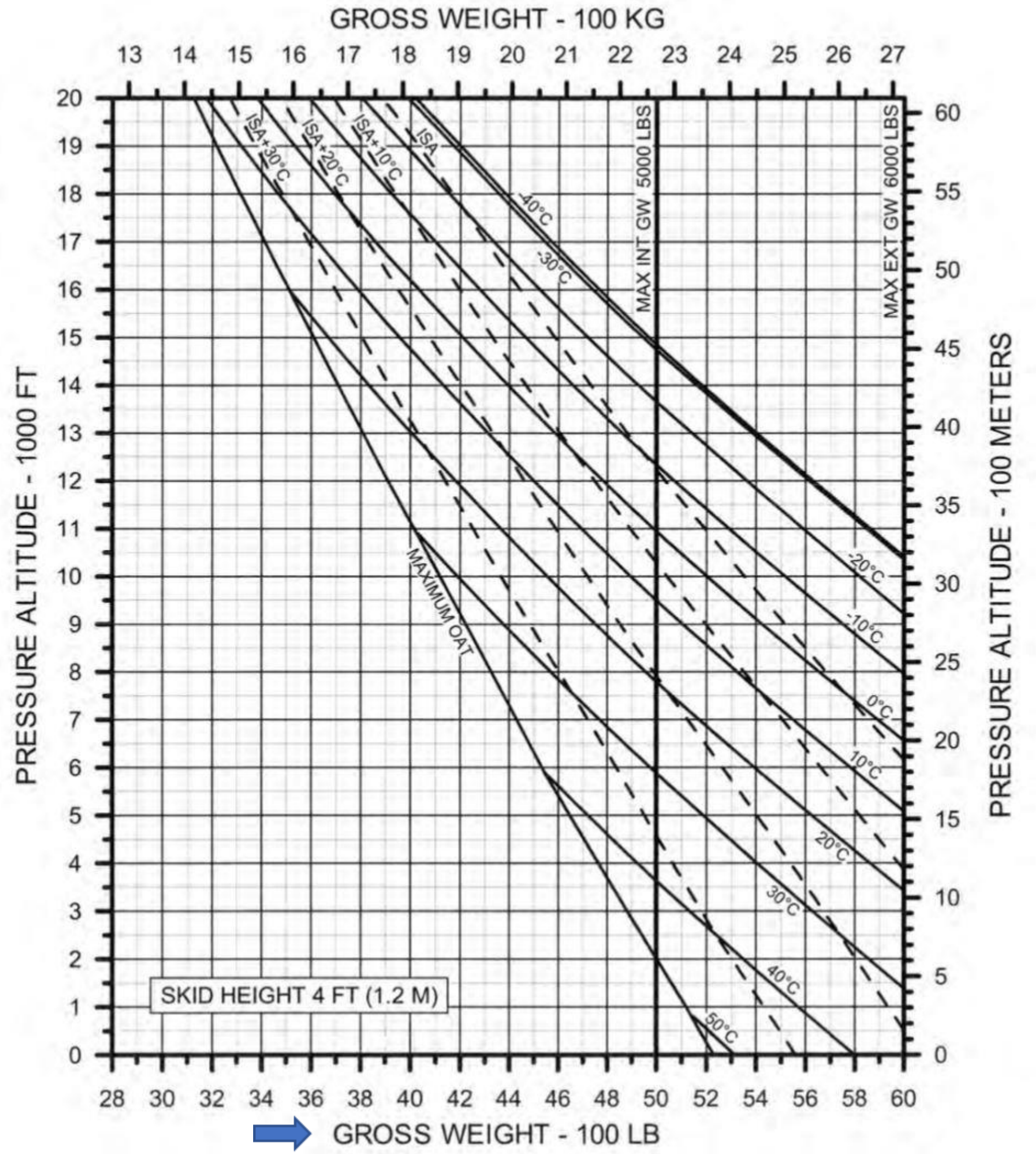
Aircraft Performance Degradation



CAAN Syllabus (FOS-10-2). Aircraft Performance, definition and practical use. Factors affecting aircraft performance, use of various performance charts……..

IGE Hover Ceiling

Rolls-Royce 250-C47B Engine at Takeoff Power
Basic Inlet Installed



Aircraft Performance Degradation

High Density Altitude means:

- **Less engine power (less oxygen molecules)**
- **Less rotor lift (High Blade Angle of Attack = Low L/D Ratio)**
- **LTE more likely**
- **OEI Ceiling closer to terrain in Twin Engine helicopters**
- **In limiting conditions, humidity will have an effect**
- **Use Rotorcraft Flight Manual performance tables**
- **Overloading can be disastrous**

PEAK EFFECT IN MID AFTERNNONS

Overloading can be Disastrous

Iran President’s helicopter accident on 19th May, 2024 -

.....main causes of the 19 May crash was bad weather conditions and the helicopter's inability to ascend with extra passengers – Fars news

Aircraft Handling is more Challenging

Weather:

- Turbulence
- Variation of ‘G’ Loading has effect on controllability (not in Rigid Rotors)
- Unexpected entry into rain can reduce visibility
- 10% increase in TAS increases Turning Radius by 20%
- Prevailing Winds for T/O & Landing – choice of wind direction limited

Terrain

- Reduced power margin & ROC. Worse when close to OEI Ceiling
- Sharp bends in Valleys and Confluences can spring surprises
- Air Traffic – keep to right side of valley
- Use Rotorcraft Flight Manual performance tables


KAZAKHSTAN
MONGOLI
UZBEKISTAN
TURKMENISTAN
IRAN
PAKISTAN
O E I !!
BHUTAN
INDIA
MYANMAR (BURMA)
Mumbai
YEMEN
Bengaluru
SRI LANKA
THAILAND
MALAYSIA

Oxygen Requirement

Breathable Oxygen must be Available/Used

- Pilots, Crew & 10% of pax if >10,000’ for up to 30 minutes
- Pilots, Crew & All Passengers >13,000’

Psychological training

- Altitude Chamber test
- Experience hypoxia in controlled environment

(O_2 partial pressure at altitude) (pulse oxymeters?)

CAAN Syllabus (FOS-10-23): General Definitions as per ICAO Annex 6, Flight operations, Aerodrome operating minima, Minimum flight altitudes, Requirement for alternate aerodrome, **Oxygen requirements**,

Reduced O_2 Effects

Hypoxia symptoms

- Significant loss of vision
- Anxiety
- Headache
- Nausea
- Slow thinking and reflexes
- Dizziness
- Numbness fingers, nose & mouth
- Fatigue
- Blurred vision
- Impaired judgment
- Subtle personality changes
- Cyanosis
- Mental Confusion
- Loss of consciousness

Hyperventilation can have similar symptoms

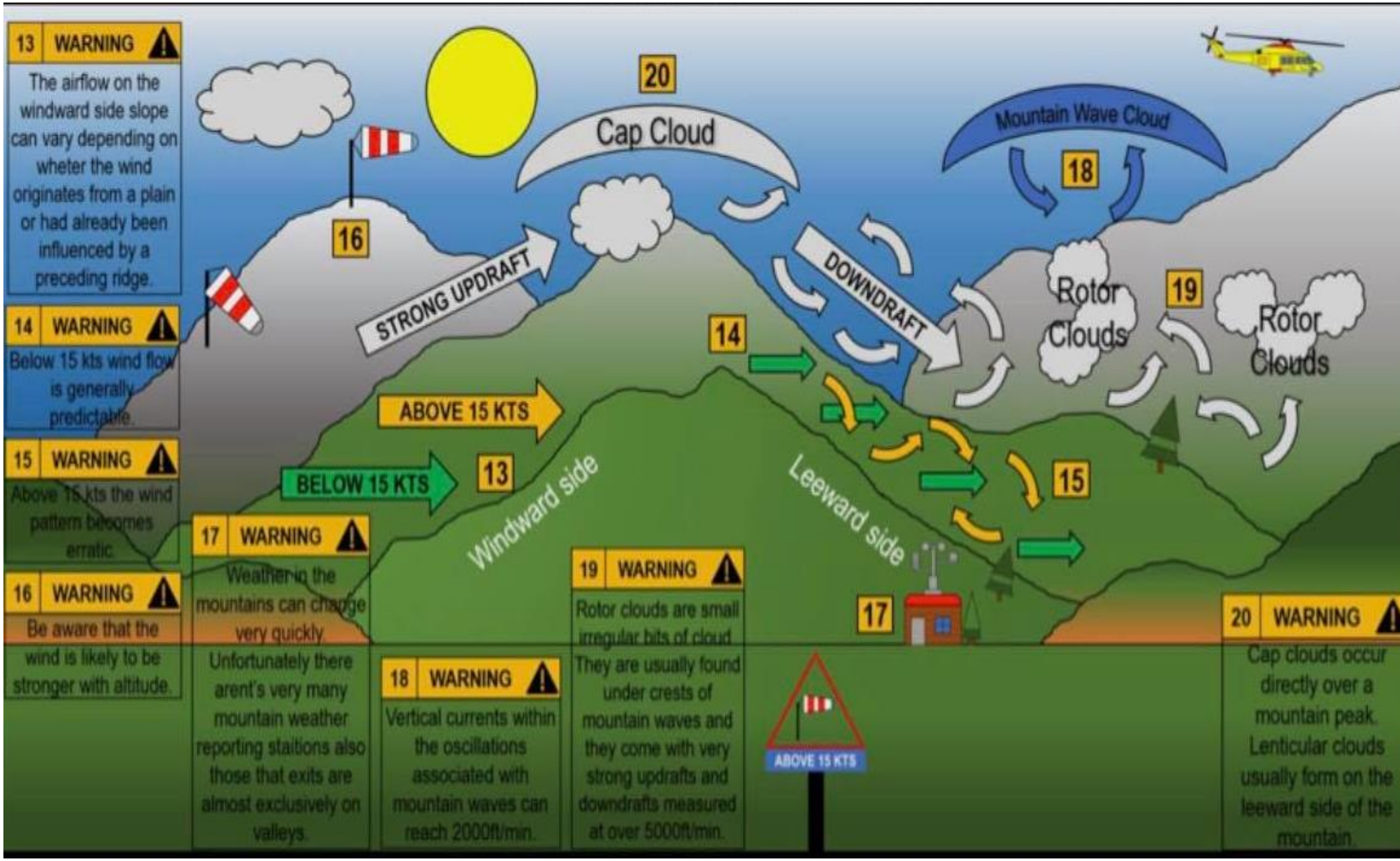
- Caused by exhaling excessive CO_2
- Usually triggered by stressful situations

CAAN (FOS-10-18): Altitude Flying Respiration and blood circulation, **Hypoxia, definition, causes, symptoms and remedy**, Time of useful consciousness, Definition, **Causes of hyperventilation, Symptoms** and remedy of hyperventilation, Blood pressure, The gas Laws, Rapid decompression, effects and counter measures, Entrapped gases.

Weather Challenges in Mountain Flying….

- **Mountain waves**
  - Lenticular clouds
  - Rotor clouds
- **Localized weather**
  - 'Weather System' changes
- **Downdrafts on lee side of mountains**
- **Cross ridges at 45^0 angle**
- **If winds > 25 Kts, danger of Rotor Clouds**
- **Temperature Inversion could result in CAP Clouds**
- **Anabatic Winds**
  - Cause thunder clouds in the afternoon
- **Catabatic Winds**
  - Cause Cb Clouds in the foothills early mornings (Changeover ~ 0930 hrs)
- **Turbulence**
  - Light, moderate, severe, extreme
  - Wind Shear in middle of valley
- **Surface Heating leads to high DA**
- **Wind speed thru passes is higher turbulence. Careful abt turbulence if > 20 Kts**

IMPORTANT: STUDY WINDS AT RIDGE LEVEL *AND* ABOVE


13 WARNING
The airflow on the windward side slope can vary depending on wheter the wind originates from a plain or had already been influenced by a preceding ridge.
14 WARNING
Below 15 kts wind flow is generally predictable.
15 WARNING
Above 15 kts the wind pattern becomes erratic.
16 WARNING
Be aware that the wind is likely to be stronger with altitude.
17 WARNING
Weather in the mountains can change very quickly. Unfortunately there arent's very many mountain weather reporting staitions also those that exits are almost exclusively on valleys.
18 WARNING
Vertical currents within the oscillations associated with mountain waves can reach 2000ft/min.
19 WARNING
Rotor clouds are small irregular bits of cloud. They are usually found under crests of mountain waves and they come with very strong updrafts and downdrafts measured at over 5000ft/min.
20 WARNING
Cap clouds occur directly over a mountain peak. Lenticular clouds usually form on the leeward side of the mountain.
20
Cap Cloud
Mountain Wave Cloud
18
16
STRONG UPDRAFT
DOWNDRAFT
Rotor Clouds
19
Rotor Clouds
14
ABOVE 15 KTS
BELOW 15 KTS
13
Windward side
Leeward side
15
17
ABOVE 15 KTS

Weather Challenges in Mountain Flying (Contd)

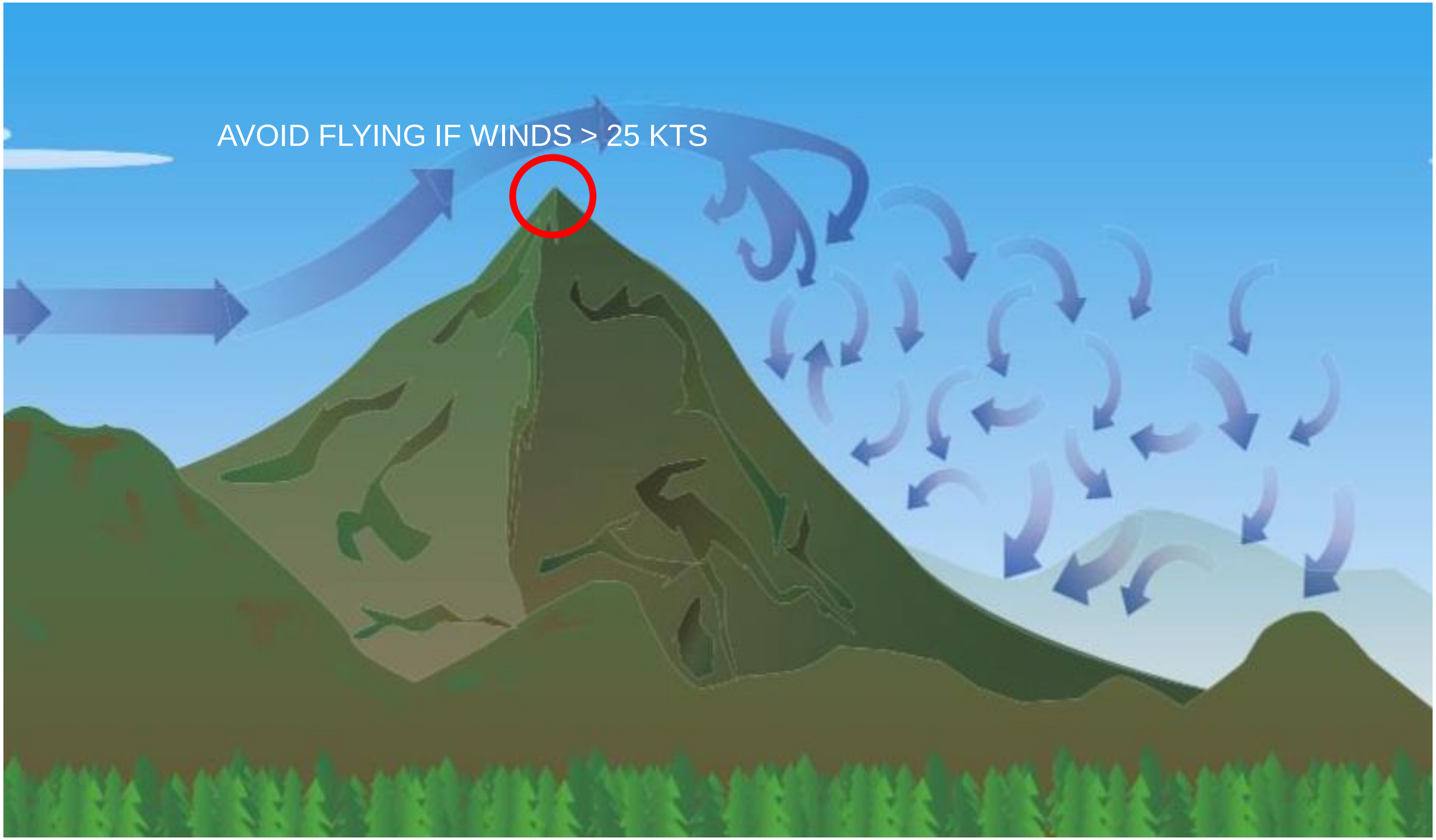
Danger of Thunderstorms (3 phases)

- **Cumulus:** storm building, good source of lift, but….
- **Mature:** rain and/or hail, updrafts & downdrafts
- **Dissipative:** mostly downdrafts, clouds more transparent
- **Rotor Clouds**
- **Wind Shear**

With atmospheric instability, Orographic Ascent can give rise to CB activity

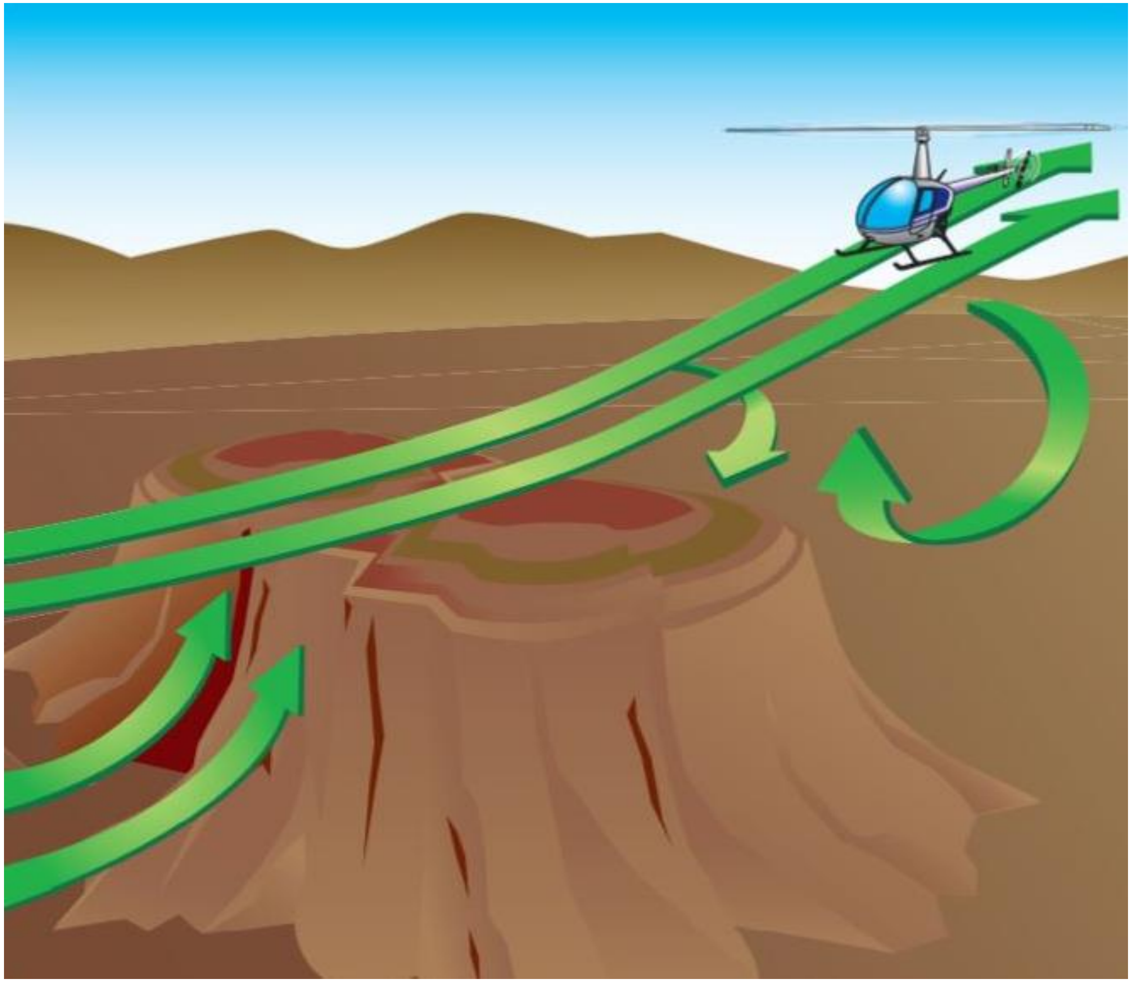
MAINTAIN A RESPECTABLE DISTANCE FROM CBs!

TURBULENCE ON LEEWARD SIDE OF HILL



POSSIBILITY OF MOUNTAIN WAVES AND TURBULENCE

PINNACLE HELIPADS HAVE SPECIAL ISSUES



- Beware of Downdraft on approach to Pinnacle Helipad
- Be ready to turn away if necessary
- Power Reserve – steep climb away may not be possible in limiting power reserve conditions

Aim to land at centre of helipad. Avoid 'dragging' approach.


Strong wind effect on tail rotor

Mountain Helipads - not very developed

Weather –
- May not have latest updates
- You may get nearby Wx by monitoring R/T
- Isolated, very unique 'Weather System'

Logistics –
- Refueling facility
- If Barrel refueling, check certificate, quality test

Communication –
- Landline/Mobile connectivity issues
- Use HF R/T if available

Road Connectivity –
- Can be an issue in an emergency
- Maintenance support would need road connectivity

MAN MADE OBSTACLES CLOSE TO HELIPADS

Weight of returning passengers/cargo may be an unknown

Ground Safety – crowd control is a Safety requirement.

Crowd control - a Ground Safety Concern

Kedarnath 23-April, 2023

Mountain Helipad Operation – Must Do’s

Over fly Helipad

- Check for surface and surrounding
- Evaluate surface conditions: unpaved, grass or rough terrain, humps and dips, snow removal
- Ensure safe approach & go around path
- Look for unexpected obstacles – new wires, outgrown trees

NATURAL OBSTACLES & WIRES CLOSE TO HELIPADS

Approach

- May be one-way in, other way out
- May require curved approach
- May have optical illusion (high or low), false horizon
- Plan your Abort/Go around point

Departure

- Decide on type of Take-off – Roller, Towering, Max Power
- Departure plan - may require a turn immediately after takeoff

Emergency Landing Spots – not easy to find

- Highways – watch out for powerlines and traffic
- Rivers – river beds can be soft and slopey
- Reservoir or lake shorelines
- Swaths cut through trees = power lines
- Small trees are better than big ones (ouch!)
- Accessibility for rescue – access to road

Develop a "Where can I set down" awareness

CAR SECTION 9 SERIES ‘C’ PART I

“**4.6** Except when necessary for take-off or landing, or except by permission from the Director General, a VFR flight shall not be flown:

a) over the congested areas of cities, towns or settlements or over an open- air assembly of persons at a height less than 300 m (1000 ft) above the highest obstacle within a radius of 600 m from the aircraft;
b) elsewhere than as specified in 4.6 a), at a height less than 150 m (500 ft) above the ground or water.

Note.— See also 3.1.2” (Emergency landing requirements to be met)

Increase the SAFETY MARGIN over and above the Regulatory Requirement!

MARGINAL WEATHER IS A CONSTANT DANGER

Please define "**Marginal Weather**"

Flight Hazards

Never fly in Marginal VFR in the mountains

Try to fly 2,000 ft above ridge lines.

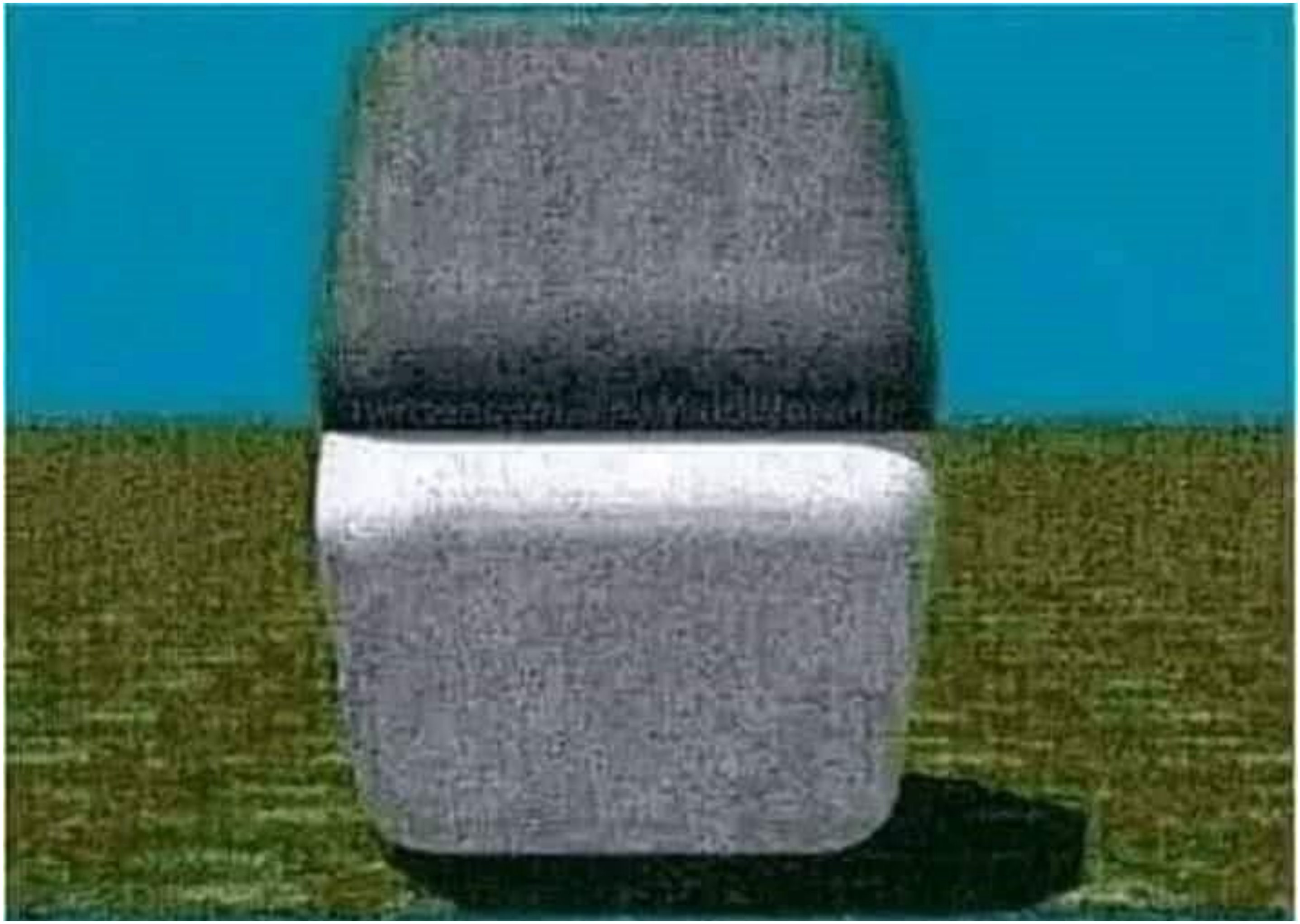
Crossing Ridges

- Cross at a 45^0 angle to the ridge line
- Position aircraft where it can be turned toward lower terrain
- If caught in strong downdraft, it may be best to accelerate away
- Aim for at least 1,000 ft clearance from Terrain Below
- Aim to be 1,000 ft below the Cloud Ceiling

Never fly down the center of a valley

- There is often wind shear in the middle
- You would give away half your turning radius
- Fly near hill side **if necessary** to get updraft
- Course reversal may be necessary

Prevailing Winds – choice of wind direction limited



Lighting Plays and Important Role. Beware of Optical Illusions

Careful preflight planning is necessary

Start with standard weather briefing

- Get the latest up-to-date weather for the route
- Check the winds aloft, ask about any NOTAMs
- Call the destination airport/helipad, or some nearby agency
- Webcam and/or Drone in Destination?

Plan for adequate fuel reserves

- You can have too much fuel – check weight
- Sometimes fuel isn't as available in mountains
- Fuel services may be available but not for you?

At higher density altitudes, plan arrival/departure before/after mid-day

Night falls quickly in the mountains

Make your Go/No go decision

Never be under pressure to go (GetHomeItis !)

If you have any nagging doubts – Don't go!

Better to be on the ground, wishing I was in the air, than vice versa.

REMOTE WEBCAM

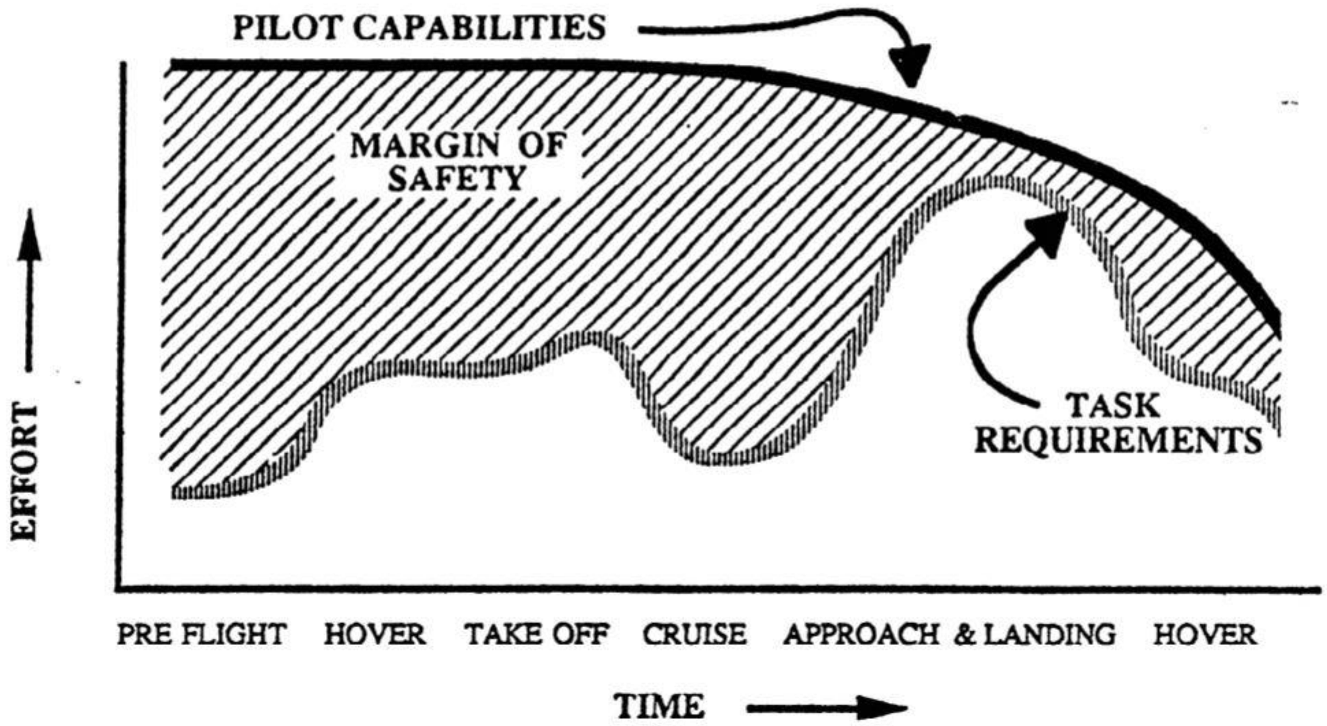
https://www.webcamtaxi.com/en/singapore/singapore-city/woodlands.html

https://airportwebcams.net/cams/new-york-manhattan-heliport-webcam.html

A Proper Flight Plan is a good Insurance

- Cater to Search and Rescue right from flight planning stage
- Adequate Fuel Reserve
- Confirm availability of fuel, refueling and quality test equipment at remote destination
- Inform destination agency of your return load limitation
- Planning should ensure adherence to SOPs

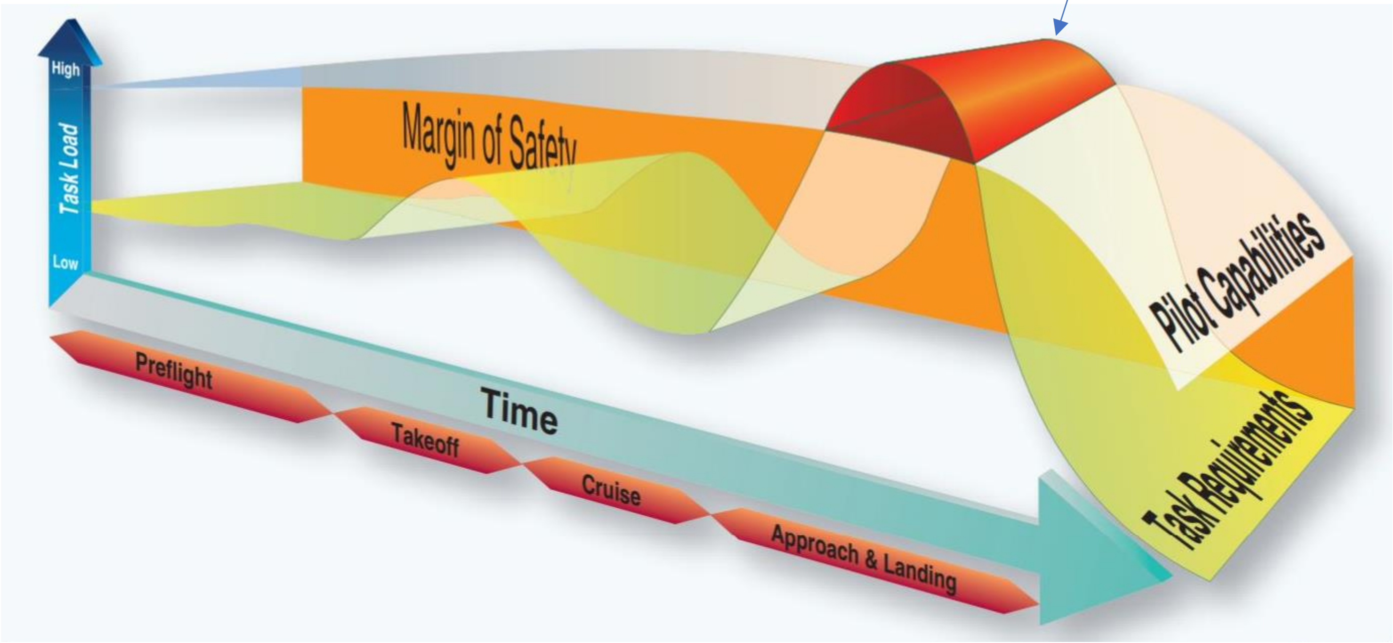
HUMAN FACTORS - TASK Vs PILOT WORKLOAD



CAAN Syllabus (FOS-10-21): HUMAN FACTORS General / Introduction to human factors 1. Need to address human factors 2. Statistics 3. Incidents

TASK Vs PILOT WORKLOAD

TASK NOT DONE
PROPERLY
Or
TASK **NOT** DONE – CHOICE
IS YOURS!



CONFINED AREA OPERATIONS

Confined-area landings – undesirable but not unavoidable. Come with significant hazards that demand careful preparation and awareness of potential risks. Follow best practices.

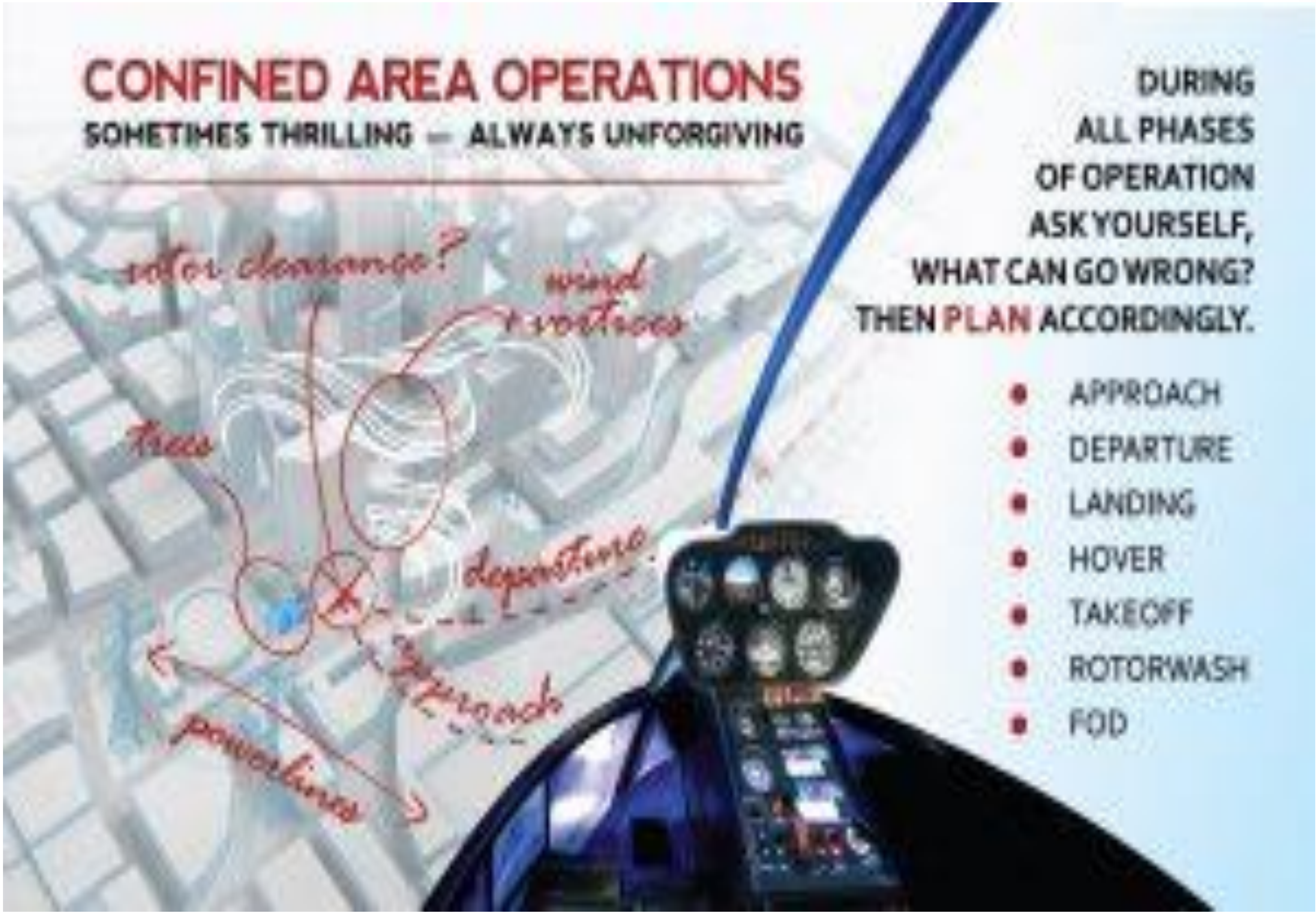
When conducting high and low recon, evaluate the following:

- **Power management:** Before attempting a confined-area landing, evaluate your power capacity for hovering both in and out of the ground effect.
- **Obstacle assessment:** As you descend into the confined area, assess potential obstacles such as buildings, trees, and terrain that could affect the aircraft's performance.
- **Rotor clearance:** Ensure that the chosen landing site provides sufficient rotor clearance. No tolerance for miscalculation.

CONFINED AREA OPERATIONS

- **Slope considerations:** Evaluate the slope for landing and shutdown.
- **Passenger safety:** Establish a safe path for passengers to approach or depart the aircraft. This should be an integral part of your planning.
- **Surface conditions:** Analyze the surface conditions - FOD, brownout, or whiteout.
- **Approach and departure paths:** Determine the optimal approach and departure paths, allow for a go-around if needed.
- **Commitment point:** Identify the point in your approach when you become committed to landing.

CONFINED AREA OPERATIONS



Pilot Qualifications

Special operations need special skills. Many regulatory authorities have laid down rules for pilot training and role-based Line Check of pilots. Some rules:

- Seat Specific Hill Flying Line Check is required once a year for pilots operating to helipads above 10,000 ft altitude.
- Role Check is mandatory once a year on type flown for External Load Operations (EOL) and Helicopter Hoist Operations (HHO).
- For Night Operations with passengers, Pilot and Co-Pilot need to have specified currency requirements.
- Flying Recurrent Training with practice emergencies is mandated. Some exercises like engine off touch-downs, hydraulic failure, Tail Rotor failure, LTE, Vortex Ring recovery etc are to be carried out in suitable simulators.
- Recurrent Training on Ground Subjects are to be carried annually.

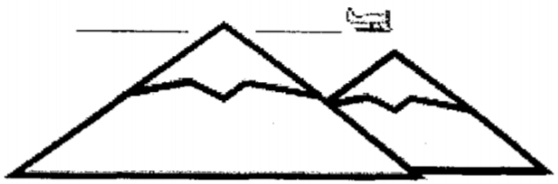
Safety through Education has shown results

SUMMARY

- ‘Mountain’ conditions possible at Sea Level as well
- Density Altitude affects airframe & engine performance
- Aerodynamic Factors
- Terrain
- Meteorology and Weather Issues
- Helicopter handling challenges
- Mountain helipad issues
- Special skills are required
- Emergency landing S & R is a challenge
- Aeromedical issues
- Human Factors

Further reading………

FAA-P-8740-60
AFS-803 (1999)



TIPS on MOUNTAIN FLYING

FAA AVIATION SAFETY PROGRAM

HELICOPTERS SAVE LIVES

Nepal Earthquake Rescue Operations by Nepal Army 206L4 – May 2015

THANK YOU

AVOIDANCE OF HELICOPTER WIRE STRIKES

29 August, 2024

KATHMANDU

Wg Cdr B S SINGH DEO, VM

THE ROTARY WING SOCIETY OF INDIA

Estd. 1998

AVOIDANCE OF WIRE STRIKE ACCIDENTS

AVOIDANCE OF WIRE STRIKE ACCIDENTS

- INTRODUCTION
- SUMMARY OF WIRE STRIKE ACCIDENTS IN INDIA (1991-2019)
- BACKGROUND INFORMATION
- OPERATING IN A WIRES ENVIRONMENT
- SURVIVING THE WIRES ENVIRONMENT (VIDEO)
- AVOIDING WIRES
- RWSI ACTION PLAN
- Qs & As

THE 1st WIRE STRIKE IN INDIA

22 November 1963, in **one of the most tragic helicopter crashes** of all times, six senior officers of the Indian Armed Forces lost their lives in an Aloutte III accident while enroute to Poonch. The casualties were :-

- GOC-in-C, Western Command (Lt. Gen)
- GOC 15 Corps (Lt. Gen.)
- AOC-in-C Western Air Command (AVM)
- GOC 25 Infantry Division (Maj. Gen.)
- Commander 93 Infantry Brigade (Brig.)
- Pilot of helicopter (Flt. Lt.)

Initially thought to be a sabotage, later confirmed a wire strike accident.

And then….

THREE CHIEF MINISTERS HAD NARROW ESCAPES WHEN THEIR HELICOPTERS STRUCK WIRES

12 Sep ’06, AS365N3 of Pawan Hans carrying the CM of Punjab struck HT wires near Bhadarpur Rahoja Village in Gurdaspur

03 Jan '07 Mi-172 of Jagson Airlines carrying the CM of Arunachal Pradesh struck HT wires near Inkiong helipad

26 May '17 S-76C++ of Maharashtra Govt carrying the CM struck HT wires on take off from Lattur helipad .

TWO WIRE STRIKES IN TWO DAYS, SAME PLACE

21 August 2019. AS350 B3 struck wires while taking off during flood relief operation in Uttarkashi, Uttarakhand. Three POB perished.

23 August 2019. Bell-407 struck wires during flood relief operation in Uttarkashi, Uttarakhand. Crew received minor injury.

WIRE STRIKE CIVIL HELICOPTER ACCIDENTS INDIA) (1991-2020)

Sl No.	Type of aircraft & Operators Govt / Commercial/ Pvt)	Date	Location	No. of Crew and Pax	Damage / Injury	Cause
1	Chetak Vayudoot (PSU)	19 May' 91	Crop Spraying near Calicut	C-1, Pax-Nil	Fatal	Pilot Error Collision with cable
2	Bell 206 L4 SpanAir (NSOP)	02 Jan 01	Low flying over Hathipaon, Mussorie	C-1, Pax-4	Fatal	Pilot Error Collision with cable
3	Lama Himalayan Heli Service Pvt. Ltd (NSOP)	29 Apr 03	Taking off near Manali	C-1, Pax-3	Fatal	Pilot Error- Collision with static obstruction

WIRE STRIKE CIVIL HELICOPTER ACCIDENTS (INDIA) (1991-2020)

Sl No.	Type of aircraft & Operators Govt / Commercial/ Pvt)	Date of Accident	Location	No. of Crew and Pax	Damage / Injury	Cause
4	Dauphin 365 N3 Pawan Hans Helicopters	12 Sept 06	While taking off from a helipad near Bhadarpur Rahoja Village in Gurdaspur, Punjab	C-2 Pax-7	Substantial damage	Pilot Error- Collision with electric wire
5	Mi-172 Helicopter Jagson Airlines	03 Jan 07	While carrying out low level recce near Inkiong airstrip, Arunachal Pradesh	C-3 Pax-27	Cockpit Perspex & Main rotors	Pilot Error- Collision with electric wire
6	AS 350B3 VT JKB Himalayan Heli Services	23 Nov '15	During approach and landing at Katra helipad (Jammu)	Crew-1 Pax -6	Destroyed. All on board were killed	Pilot Error Probable Bird Hit on control tubes followed by wire strike during landing

WIRE STRIKE CIVIL HELICOPTER ACCIDENTS (INDIA) (1991-2020)

Sl No.	Type of aircraft & Operators Govt / Commercial/ Pvt)	Date of Accident	Location	No. of Crew and Pax	Damage / Injury	Cause
7	AS 350 B3e Heritage Aviation Pvt Ltd	21 Aug 19	During route flying in Uttarkashi, Uttarakhand	Crew-2 Pax -1	Helicopter destroyed. All on board killed	Under investigation
8	Bell 407 Aryan Aviation Pvt Ltd	23 Aug 19	During route flying in Uttarkashi, Uttarakhand	Crew-2	Pilots sustained minor Injuries & helicopter severely damaged	Under investigation

Two cases where wires were the cause of accidents.

WIRE STRIKE CIVIL HELICOPTER ACCIDENTS (INDIA) (1991-2020)

Sl No.	Type of aircraft & Operators Govt / Commercial/ Pvt)	Date of Accident	Location	No. of Crew and Pax	Damage / Injury	Cause
9	AS 350 B3e Heritage Aviation Pvt Ltd	xx Oct 20	During Taxiing in Patna	Crew-2 Pax -1	Helicopter damaged. All on board safe	Under investigation

Union Minister on Board.

Even the *slightest* wire strike can cause *immense damage*

Any encounter with wires must be reported and investigated.

WIRE STRIKES & COLATERAL DAMAGES

Consider the enormous cost of causing a power outage to customers and the repair costs.

BACKGROUND TO WIRE STRIKE ACCIDENTS

CAR SECTION 9 SERIES ‘C’ PART I

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b) elsewhere than as specified in 4.6 a), at a height less than 150 m (500 ft) above the ground or water.

Note.— See also 3.1.2” (Emergency landing requirements to be met)

WIRE STRIKE ACCIDENTS - BACKGROUND

- Wire strikes by helicopters happen **often**, and frequently result in **fatalities**. The US HST found that 16% of ***ALL*** rotary-wing accidents involved wire or obstacle strikes.
- An FAA study of wire-strike accidents between 1994 and 2004 found 41 of 124 were fatal.
- Accidents included helicopters striking power lines, telephone wire or a supporting structure like a tower.
- 86% of the fatal accidents occurred in ***CLEAR WEATHER*** with ***GOOD VISIBILITY!***

WIRE STRIKE ACCIDENTS ARE **AVOIDABLE**!

WIRE STRIKE ACCIDENTS - BACKGROUND

- Per NTSB, probable causes of the 124 aircraft accidents in the study included *inadequate visual lookout* (38 accidents) and *failure to maintain sufficient clearance with the obstacle* (59 accidents)

- Other reasons (for the remaining 27 accidents) included:
  - improper *judgment*
  - failure to maintain a proper *altitude*
  - inadequate *preflight planning*
  - failure to *see* and *avoid wires*
  - *intentional buzzing*
  - selection of an *unsuitable landing area*

AVOIDABLE?

WIRE STRIKE ACCIDENTS - HEMS

HEMS operational environment is a spiderweb of wires.

- Flight Safety Foundation's 2001 Report – "Human Error is the Major Cause of U.S. HEMS Accidents".
- Of the 87 accidents and 56 incidents involving U.S. commercial HEMS helicopters between 1987 and 2000, 15 accidents and 12 incidents involved **wire strikes**
- Efficacy of the admonishment **"exercise better see-and-avoid"** doesn't seem to work!

WIRE STRIKE ACCIDENTS & FAT LOG BOOK

"It is a ***myth*** to think that more time in the cockpit will make you safer in the wire environment."

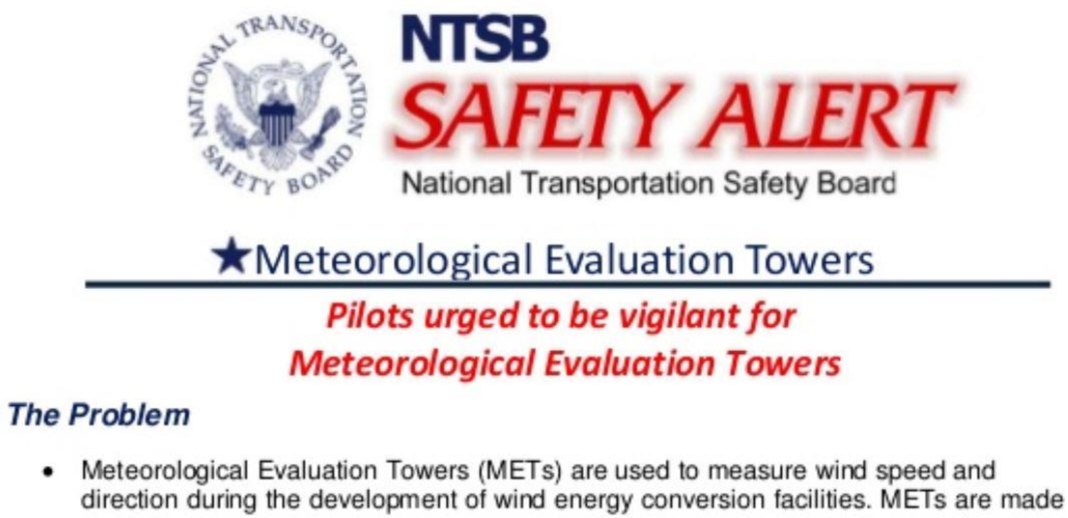
The FAA report found:

- Average age of pilots involved **-** **43.5** years
- **78%** of the accidents involved pilots between the ages of **40** and **59**
- Average flight experience of pilots - **3,575 hrs**

What should grow with experience – Confidence or Maturity?

WIRE STRIKE ACCIDENTS – A GROWING CONCERN

- Society's progress has led to proliferation of new telecom antennas and power transmission towers, along with thousands of Kms of wire.
- In addition, wind generators and Meteorological Evaluation Towers (METs) are being erected. The slender METs are nearly impossible to see and are often supported by nearly invisible guy-wires.



NTSB SAFETY ALERT
National Transportation Safety Board

★Meteorological Evaluation Towers

Pilots urged to be vigilant for Meteorological Evaluation Towers

The Problem

- Meteorological Evaluation Towers (METs) are used to measure wind speed and direction during the development of wind energy conversion facilities. METs are made

INVISIBILITY OF WIRES…

Factors

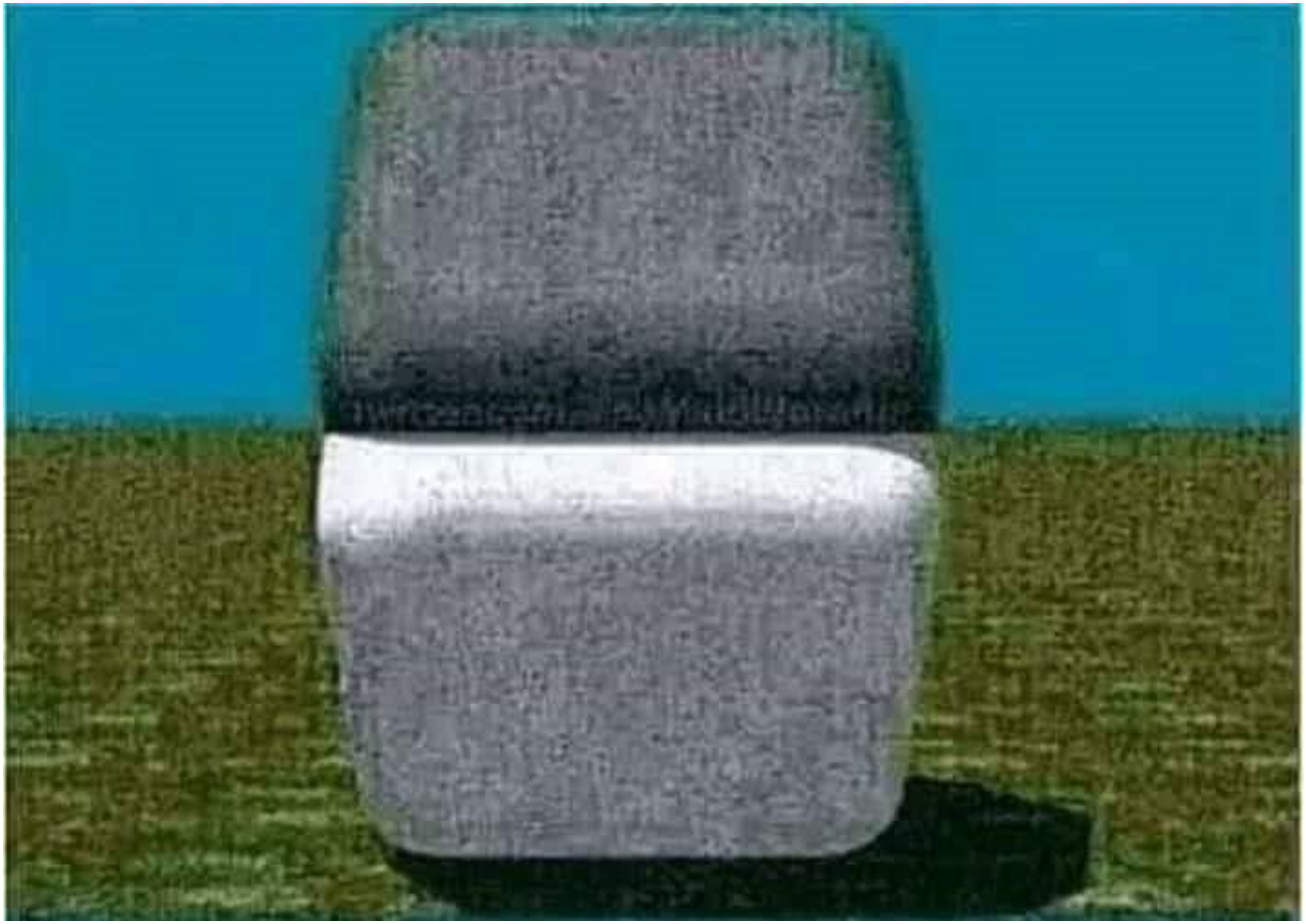
- Size
- Atmospheric Conditions
- Viewing Angle
- Sun Position
- Visual Illusions

INVISIBILITY OF WIRES

Factors

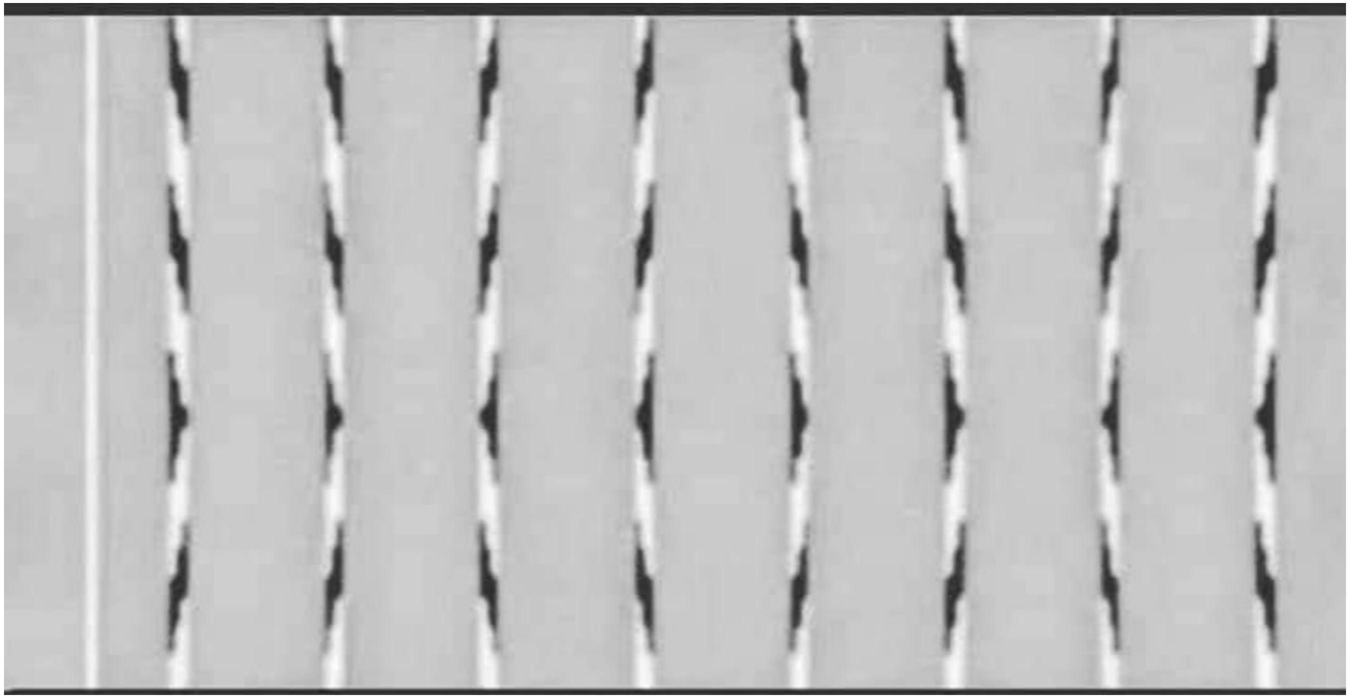
- Pilot Scanning Abilities
- Visual Acuity (*Vertical Vs Horizontal obstructions*)
- Cockpit Workload
- The Camouflaging Effect of Nearby Vegetation
- The condition of the aircraft’s transparencies

OPTICAL ILLUSIONS



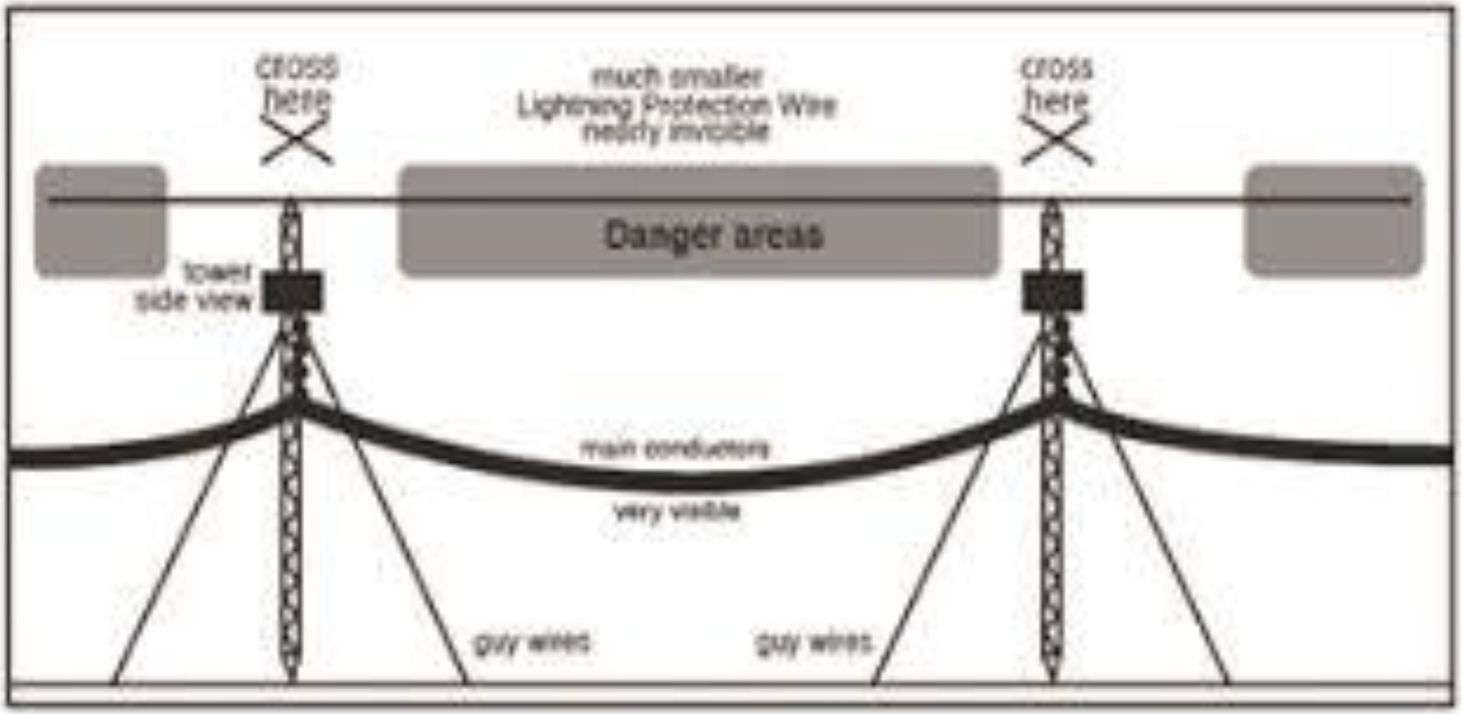
Light plays an important role in Colour Perception

OPTICAL ILLUSIONS



ALL LINES ARE STRAIGHT, BUT DON'T APPEAR TO BE SO

KNOW THE POWERLINES



TYPICAL 'WIRE' SCENARIO

SPOT THE 'ENEMY'

Danger of missing the thin wires

W
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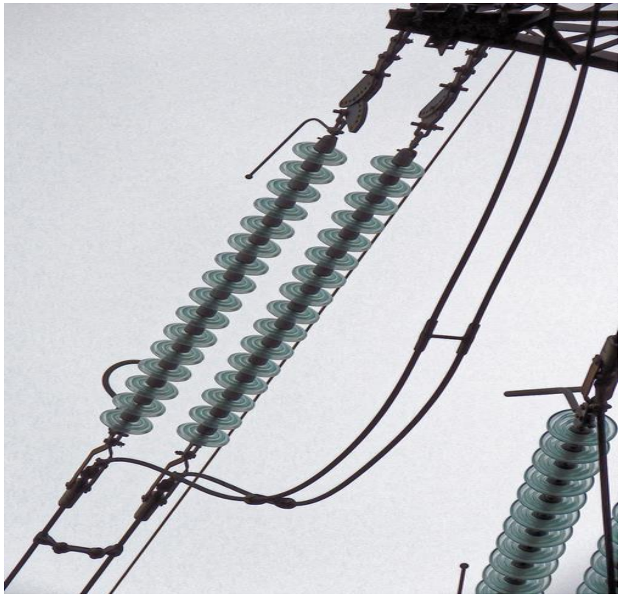
?

INSULATORS ARE EASILY DETECTED

Forecast the presence of wires long before you actually see them? Observing **insulators** can help **flight crews predict** wire patterns, especially when the power line makes a turn.



Not SEE & AVOID **AVOID BEFORE SEEING!**

FLIGHT PLANNING

- Flight Planning should include marking of known Power Lines and Obstacles. (Not carrying a Map?)
- But not all wires and towers are charted. Aviation maps/charts can not keep up with the expanding wires environment.
- Define a Minimum Safety Altitude/Height

So watch out –

Even in a 360-deg high reconnaissance, a tiny wire can pass out of view within seconds.

WIRE STRIKES – **ALWAYS** BE ON GUARD

Being aware of a wire is no guarantee of avoiding it. According to "Surviving the Wires Environment," a training video co-sponsored by the FAA, HAI and Southern California Edison, **40%** of the pilots who have hit wires ***knew it was there*.**

One interviewee commented, **"You will let your guard down momentarily, and that is what will get you!"**

SOME EXPERT VIEWS….

Dr. DeHaan, an expert says – “The pilot has to aim his eyes in the right direction, then perceive there is a wire, then project his flight path and make a decision whether there is a collision potential, then make a decision on the evasive action, then move the controls. It takes time for the aircraft to respond. This can take 5 or 6 sec.”

He adds, “Pilots notoriously have the misconception that they will see wires in time flying at wire level.”

The FAA’s safety study points out that the pilot’s view of the outside can be affected by the vibratory environment of the cockpit. The human eyeball and intra-ocular structures have natural frequencies in the 20-Hz to 90-Hz range. Most helicopters have structural frequencies in the 20-Hz range. This means that a pilot’s visual performance will deteriorate after prolonged exposure to certain vibrations.

SOME EXPERT VIEWS

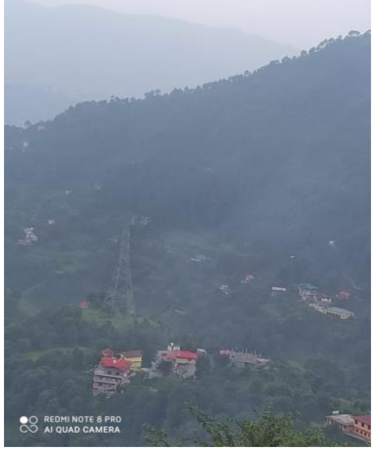
Robert Feerst, another expert, emphasizes that **pilots need to know what the *enemy* looks like**, which includes how to identify the hazards associated with wires. Normal mainstream **aviation education does not teach these important points.**

FAA's study stresses that pilots need to be exposed to **techniques of recognizing** different types of wires, including powered and guy wires, and to **anticipate their location**. They need to **identify** the **power grid system** and determine wire direction from the orientation of the insulating connectors on various towers.

Problem – Pilots are not aware of newly set up Powerlines

IMPORTANCE OF CRM

Flight nurses and any other crewmember should act with the pilot as a team. They should be thoroughly versed in procedures and inflight communications. "Everybody has to be speaking the same language."



FAA's safety study recommends helicopter pilots avoid cruising below 750 ft. But in the hilly terrain wires stretch across the ridges.

Television broadcast antennas are as high as 2,000+ ft. tall and have guy wires anchored from 1,600 ft. to 2,000 ft. from the base of the structure.

DEPENDING ON TERRAIN, SOPs SHOULD LAY DOWN SAFETY ALTITUDE

FLYING NEAR POWER LINES…

- Remain on right-hand side of direction of flight and watch for cross lines and guy cables.
- Expect radio and electrical interference in the vicinity of power lines.
- For operational low flying, do an over flight and map check first.
- Leave yourself an “out” - cross at 45 degrees to the line. Reduce speed in low visibility.
- Cross Power Lines at the Towers, never midway where the sagging wires are at their lowest.

Flying Near Power Lines

- Sure way of reducing risk - Stay clear of wires. The FAA's safety study *recommends* helicopter pilots avoid cruising below 750 ft.
- In hilly terrain watch out for wires stretching across the ridges.
- *Consciously* Maintain Situational Awareness
- Two-Pilot operation gives you better lookout

TRAINING - MUST BE *FORMAL* AND *COMPREHENSIVE*

Learn to:

- scan for wires effectively
- know what you can and can't see and why
- tactics for flying in the vicinity of wires
- know about obstructions and marking schemes

A "short course" is not sufficient. Refer www.helicoptersafety.com to see the comprehensiveness offered by respected organizations in this field.

It is strongly recommended that pilots and crews who work in close proximity to powerlines undergo formal and more-detailed wire-strike safety training.

No 'Crash' Courses!

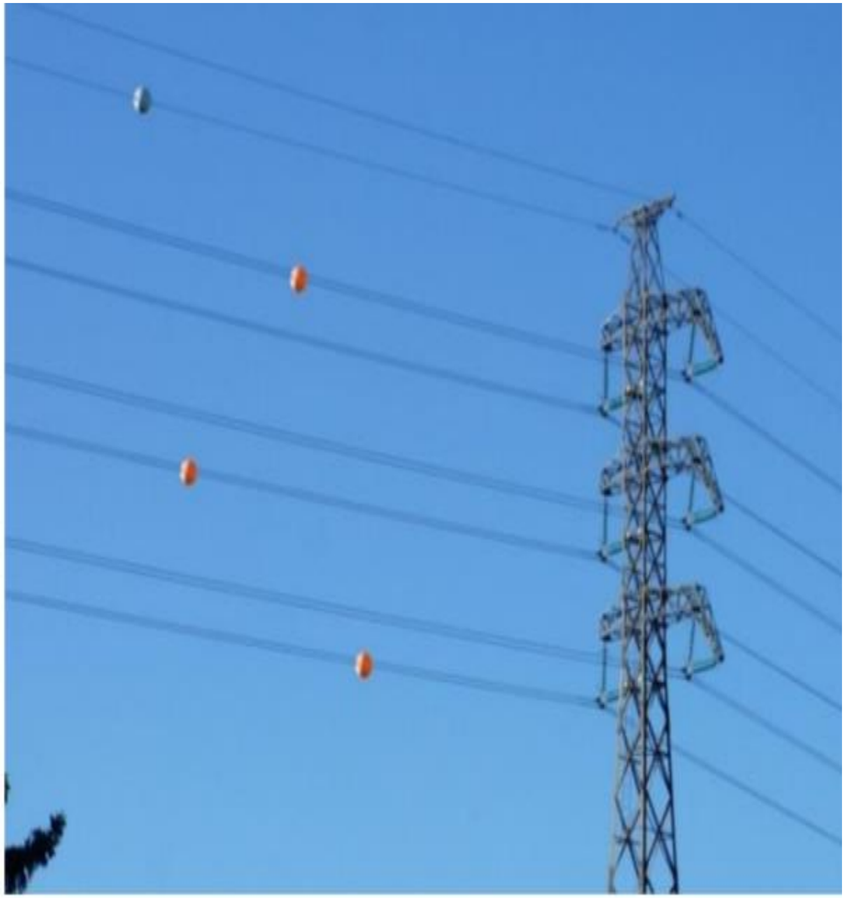
SURVIVING THE WIRES ENVIRONMENT - VIDEO

https://www.google.com/search?q=surviving+the+wire+environment&rlz=1C1CHBF_enIN808IN808&oq=surviving+the+wire+environment&aqs=chrome..69i57j0.10765j0j4&sourceid=chrome&ie=UTF-8#kpvalbx=_4aoVX_fDB7Lmz7sPpN6D0Ac22

SHORT BREAK

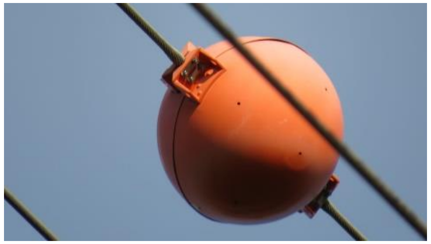
WIRE STRIKE PREVENTION

LIFE MADE EASY



HOW TO SURVIVE IN THE WIRE ENVIRONMENT

1. Markers

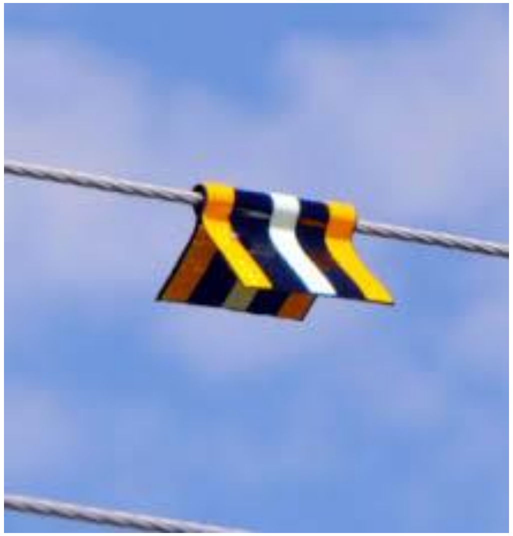


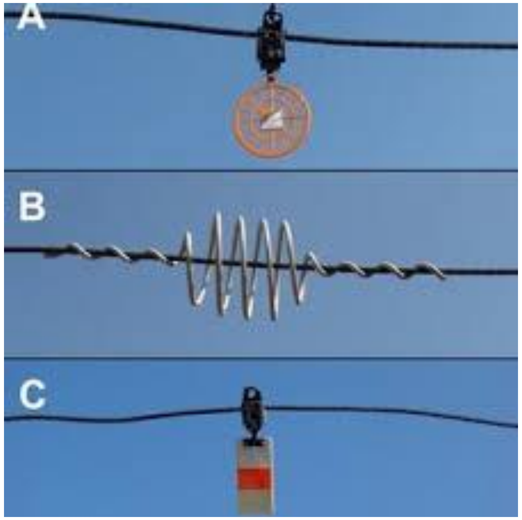
2. Detectors

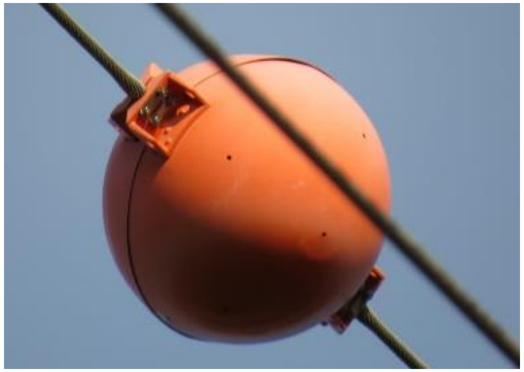
3. Cable Cutters

DON'T FORGET TRAINING!

POWER LINE MARKERS







Powerline Marker Installation Video

https://eur06.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdrive.google.com%2Ffile%2Fd%2F1X_sCqv3A0FzuPsnALfZDDZMtGL-aTGfZ%2Fview%3Fusp%3Ddrive_web&data=02%7C01%7C%7C3e8c68ec212d4d7a22b508d82c93391b%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C637308358118355876&sdata=HaQhBK1ntyMjV6HyxUcCNVReW0tw7UMCJfObKLNbo84%3D&reserved=0

WIRE STRIKE PROTECTION AND WARNING SYSTEMS

AIRBORNE SYSTEMS

POWER LINE DETECTORS

- System senses proximity to a powerline and uses audio and visual warning signals to alert the pilot.
- Incorporates a Very Low Frequency (VLF) receiver sensitive to powerline's electromagnetic fields. System sensitivity is adjustable. Self test feature provided.
- A red warning light remains ON as long as a powerline is sensed. An audio alert is also heard through the audio system and increases in frequency as the powerline gets closer. (Can be muted if desired).
- Light weight, about 1.4 kgs.

WIRE STRIKE PROTECTION AND WARNING SYSTEMS

The OASys:

- Nose mounted Radar transmits a 35-GHz radio frequency for detecting obstacles in the flight path.
- System uses data from the aircraft's GPS receiver to calculate the aircraft's flight path for the succeeding 19 seconds.
- Three zones of increasing potential risk are designated.
- Pilot is notified by a display in the cockpit that illuminates based on the distance and direction to the obstacle.
- During takeoff, the system scans a wide angle around the helicopter, but range is small. In cruise at high speeds, the scan narrows, but range increases.

WIRE STRIKE PROTECTION SYSTEMS

The WSPS™ Wire Strike Protection System™ provides protection for helicopters in the event of inadvertent flight into horizontally strung electrical transmission wires.

WSPS VIDEO

https://www.youtube.com/watch?v=rm6MwIdY4TA

SUMMARY

- Know the wires environment (need help from Power Grid Corporation)
- Dangers and difficulties in ‘seeing’ the wires
- Expert views
- Operating techniques
- Importance of following regulations and SOPs
- Warning and Protection Systems

PILOT IS FINALLY RESPONSIBLE FOR SAFE OPERATIONS

THE ROTARY WING SOCIETY OF INDIA

(Registration No. Govt. of NCT Delhi D-33154 of 18 June 1998)
Participating Society of Aeronautical Society of India (AeSI), Affiliated to Helicopter Association International (HAI), American Helicopter Society (AHS), International Federation of Helicopter Association (IFHA) and Business Aircraft Operators Association (BAOA)

Ref. : RWSI/MoCA/Corres **Date : 14 May 2020**

To
Chief Secretaries of all states
Chairman Power Grid Corporation of India
Dms of all districts

COLLISION WITH WIRES (WIRE STRIKE) HAZARD TO LOW FLYING HELICOPTERS

Dear Sir,

Greetings.

Reference is made to this Ministry's earlier letters No. .... dtd. .... on the above subject.

As Civil helicopter operations are likely to increase many folds in our country in the coming years, Wire Strike (Collision with wires) accidents are of serious concern especially in mountainous states where ropeways /cables are used in carting farm products across valleys. Many of them spring up at short notice-based on needs.

As Civil helicopters are extensively used in mountainous states, unmarked

There is a need for the Dist. Administration in your State to consider implementing the under mentioned recommendations to prevent future Wire Strike Helicopter accidents: -

(a) Unmarked ropeways /cables in valleys, Transmission lines and Supporting towers in the vicinity of airfields/helipads need to be marked by luminous balls/markers at short intervals. (Please see the pics at frame 1 at Appendix A attached).

(b) The pylons must be illuminated and marked by approved obstruction lighting. (Please see the pics at frame 2 at Appendix A attached).

(c) All poles and pylons which carry wires must be painted according to obstruction markings. (Please see the pics at frame 3 at Appendix A attached).

With kind regards

Smt Usha Padhee IAS
Joint Secretary
Ministry of Civil Aviation
New Delhi

Five survive crash in Bali after helicopter gets entangled in Kite Strings

Looking for suggestions to prevent redux

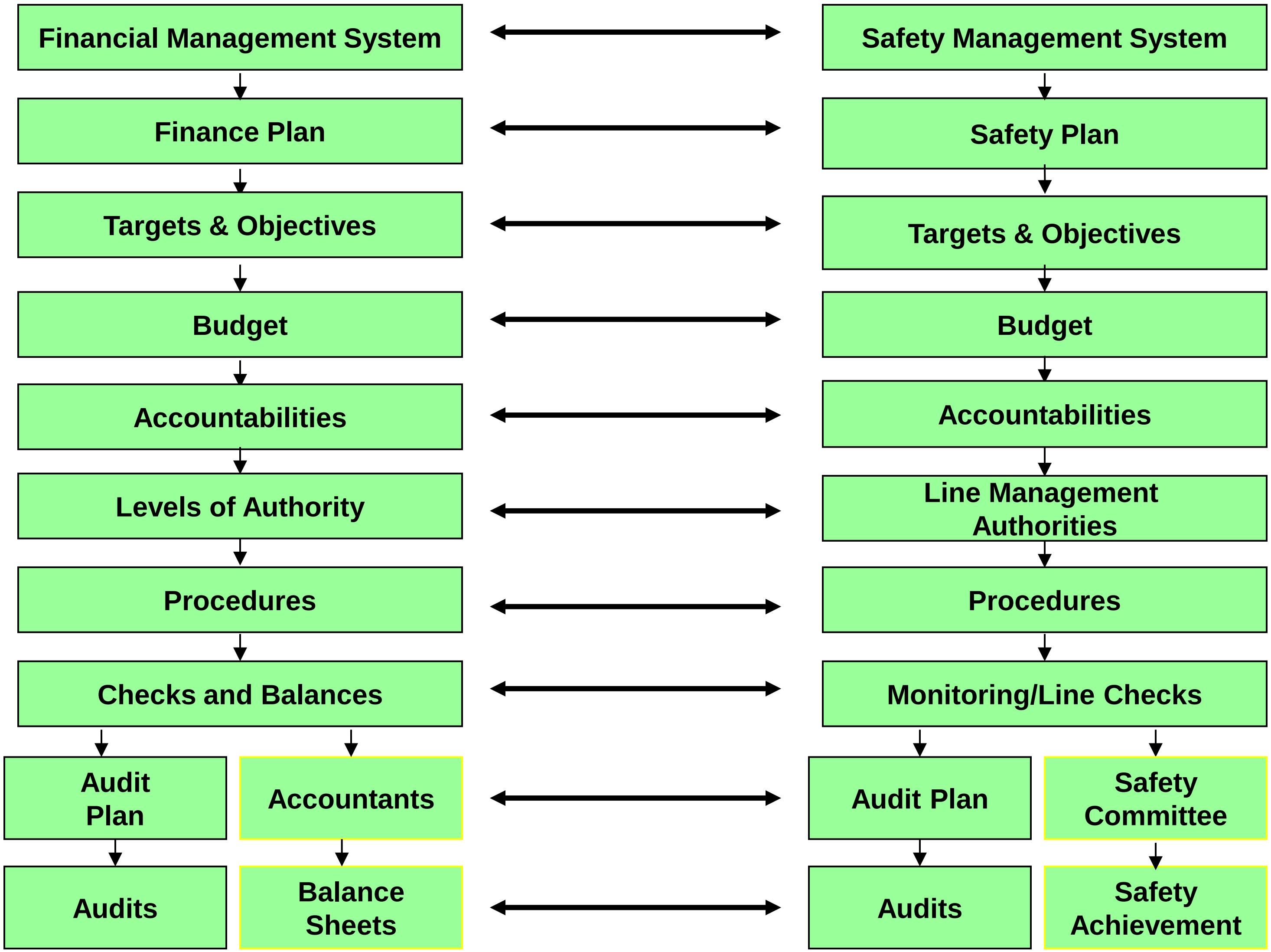

THANK YOU

Evolution of Safety Concepts & CFIT

Kathmandu, 30 August, 2024

Wg. Cdr. B. S. Singh Deo (Retd.)
VP, RWSI

MANAGEMENT SYSTEM = SAFETY SYSTEM



IHST Initiative -

THE CASE FOR SAFETY MANAGEMENT SYSTEMS (SMS)

What is IHST?

- **2005 – Somen Chowdhury initiative. IHST is formed. DGCA & RWSI attend Montreal meeting.**
- **2006 – Safety Target set in Montreal IHSS**
- **2007 – Workshop in India – Data Mining Matrix**
- **2008 – ICAO approved SMS introduced by IHST**
- **2009 – RWSI attends IHSS. SMS Introduced in India**
- **2010 – RWSI attends IHSS in Lisbon. Comment – “We have a lot to learn from India”. IHST India invited to join quarterly teleconference.**

RWSI BECOMES PART OF A GLOBAL INITIATIVE

INTERIM REPORT Oct 2010

A Commitment To Safety!!

FLIGHT SAFETY FOUNDATION REPORT 13 OCT 2010:

Global civil helicopter accident rate has dropped from:

9.4 per 100,000 flight hours in 2005

5.4 per 100,000 flight hours in 2010

WE ARE ON TRACK!

INDIAN SCENARIO

- RWSI Analysed 55 Civil Helicopter Accidents from FY 1990 to 2009 - found 10 CFIT Accidents.

- In all the 10 accidents analysed, the pilot lost situational awareness and inadvertently flew the aircraft into the water/mountain-slope because of the combined effects of the lack of external visual references and weak instrument flying skills.

- All elements of human errors including <u>decision errors</u> ("thinking" errors), <u>skill based errors</u> ("doing"errors), <u>perceptual errors</u> (errors due to degradation of sensory inputs) and <u>violations of safety norms</u> were found .

CONTROLLED FLIGHT INTO TERRAIN (CFIT)

WHAT IS CFIT?

Controlled Flight into Terrain (CFIT) occurs when an airworthy aircraft under the control of a pilot is inadvertently flown into terrain, water, or an obstacle with inadequate awareness on the part of the pilot of the impending disaster.

CFIT accidents typically are a result of pilot or navigational system error.

ABOUT CFIT

CFIT INCLUDES

- ✓ Occurrence during airborne phases of flight.
- ✓ Collisions with those objects extending above the surface (e.g: Towers)
- ✓ Occurrence during either Instrument Meteorological Conditions (IMC) or Visual Meteorological Conditions (VMC)
- ✓ Instances when the cockpit crew is affected by visual illusions (e.g., black hole approaches) that result in the aircraft being flown under control into terrain, water, or obstacles.

CFIT EXCLUDES

- ✓ Control of the aircraft lost (induced by crew, weather or equipment failure), Loss of Control – In-flight (LOC-I) is used instead.
- ✓ For an occurrence involving planned low altitude operations (e.g., crop dusting) Low Altitude Operations (LALT) code is used instead of CFIT.
- ✓ Occurrences involving intentional flight into/toward terrain. Suicides are coded under Security Related (SEC) events.
- ✓ Occurrences involving runway undershoot/overshoot, which are classified as Undershoot/Overshoot (USOS).

CFIT ACCIDENTS

&

HUMAN FACTORS

"As aircraft became more reliable and less prone to mechanical failure, the percentage of accidents related to human factors increased."

Humans account for 74% of all rotary wing accidents!!

CFIT AND HUMAN ERROR

A CFIT accident necessarily implies that :

- **the crew ‘busted altitude’**

  i.e. they were flying the aircraft outside of the airspace in which it is legal to fly an aircraft under IFR, in particular, below minimum altitudes for instrument flight in that area.

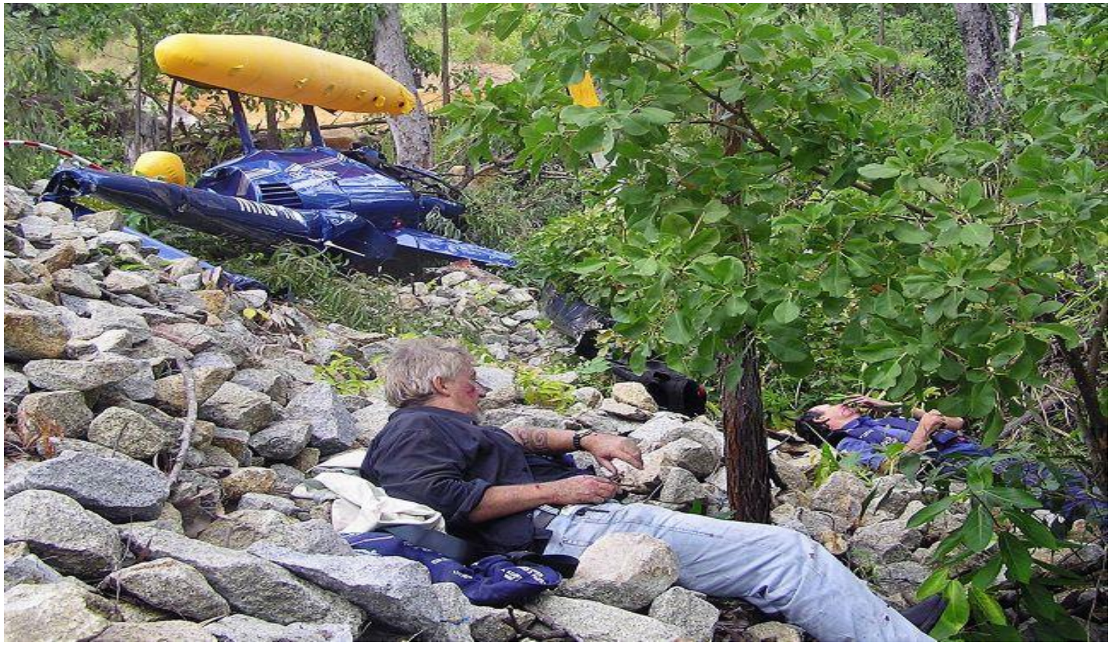
- **and that either they did so intentionally, or they had lost ‘situational awareness’** i.e. they didn't know where they were in relation to the ground and the airspace through which they were flying.

But they had flown the aircraft there.....

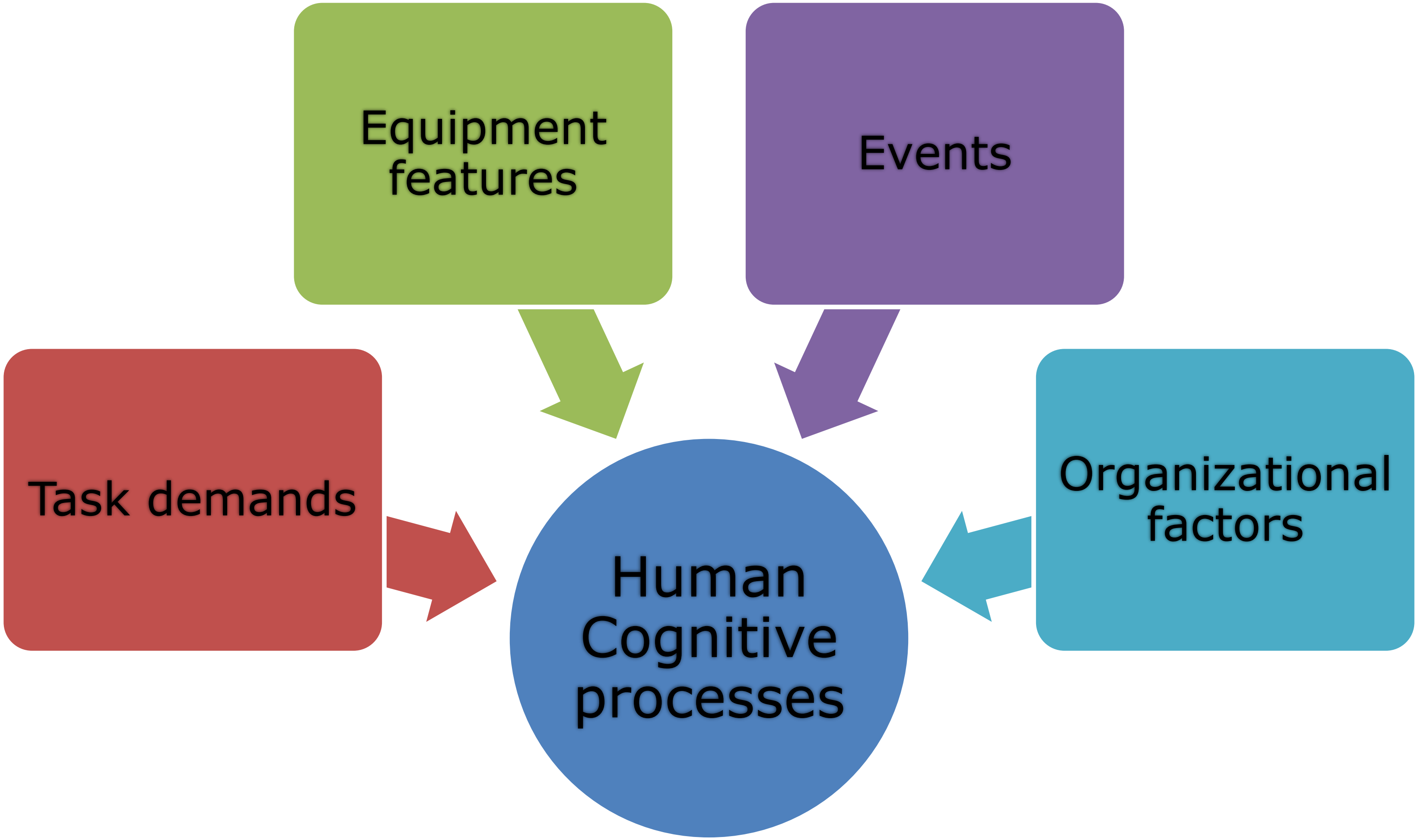
WHY?

Why would highly experienced pilots forget to perform routine tasks?

- Carelessness?
- Lack of skill or proficiency?
- Overwhelmed by workload?
- More subtle issues?



A NASA STUDY: The Limits Of Expertise

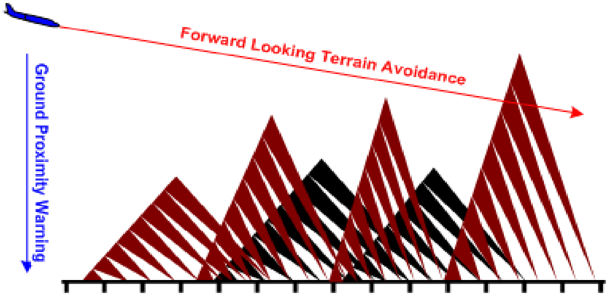


How Can Personality Affect Mechanics and Pilots??

Most Common Factors That Determine A Pilot's Situational Awareness

PREVENTION

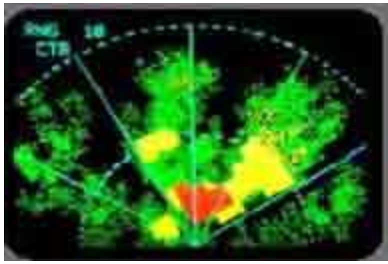
CFIT prevention can be grouped in two main categories:



EQUIPMENT

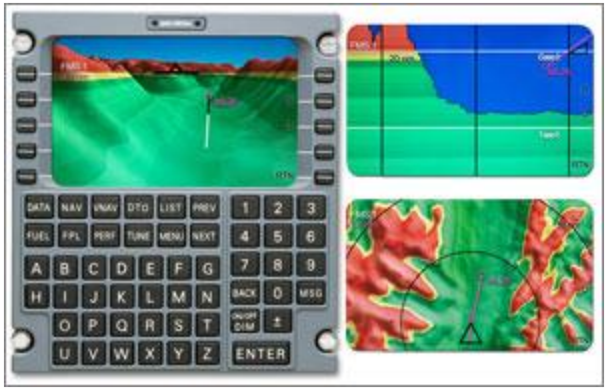
TRAINING/ EDUCATION

Equipment



Global Positioning Systems (GPS) :

- **Ground Proximity Warning Systems (GPWS)**
- **Terrain Awareness and Warning Systems (TAWS)**



- TAWS compares the aircraft's present position, as determined from the aircraft's navigation system, with an onboard terrain database.

-TAWS provides an aural and/or visual warning to the pilot, enabling corrective action even in instrument flight or night conditions.

⇨ Increased navigation capability and accuracy, instrument approaches in locations where no ground-based approach aids are available and better situational awareness.

GPWS v/s EGPWS

- New system provides a full 60s advanced warning of hazardous terrain. A conventional GPWS may give pilots as little as 10s to take avoiding action.

- The system also allows pilots to select a visual display of hazardous terrain below and ahead of the aircraft - crucial in poor visibility or darkness.

Currently EGPWS is prefered

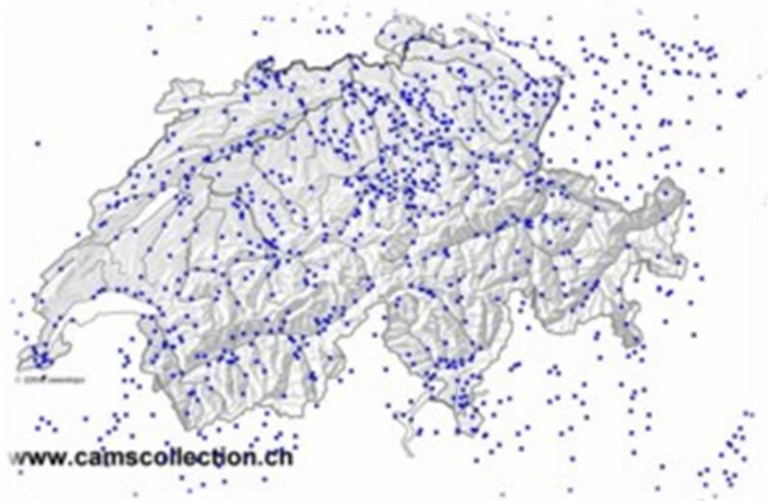
OTHER SOLUTIONS

- Operators think up-gradation to modern fleet will reduce accidents.
- Operators expect manufacturers to design safer helicopters.
- Safety related equipment are being marketed more than ever before.

INNOVATION –
USE THIS UNIQUE HUMAN TRAIT

- Installation of weather web cams along the coastline and across the scheduled routes

- For example : www.camscollection.ch



Over 3,400 weather cams in Switzerland and neighbouring countries

TO SUM IT UP…

- Modern helicopter design must make helicopters safer.
- Modern equipment are now available and must be used.
- Training is the most important factor.
- Focus on cultural shift towards safety in everything – Zero Tolerance.

HAI (now VAI) Initiatives

Carelessness and Overconfidence are more dangerous than deliberately accepted risk.

Wilbur Wright
1901

Late Matt Zuccaro's golden words :

- LAND AND LIVE - 2012
- SHUT UP AND LISTEN - 2014

Matt's Campaigns have saved many lives

Drukair helicopter makes emergency landing in paddy field due to severe weather

August 19th, 2024 | Post Views: 277 |

Sherab Lhamo

On August 17, at around 2:48 pm, a Drukair helicopter was forced to make an emergency landing in a paddy field in Issuna, Paro.


Thank You!!

Human Factors in Aviation

Wg. Cdr. B. S. Singh Deo, VM (Retd.)

Kathmandu, 30 August, 2024

Why is Human Factors Training Important?

- **“As aircraft became more reliable and less prone to mechanical failure, the percentage of accidents related to human factors (human causes) increased.”**

- **Humans account for approx. 74% of all rotary wing accidents.**

Value of HF Training

- Human Factors Training fosters a positive safety culture
- Critical to include leadership
- Improves work performance, physical & psychological health
- Training on regulations, procedures & equipment affecting job performance
- ICAO & many aviation authorities mandate HF training – it impacts safety & quality

Human Factors

- **Studies interaction between people and machines to improve performance and reduce errors.**

- **Reference: FAA Instrument Flying Handbook; FAA-H-8083-15**

Some Basics of Human Factors

Human Factors

- **Physiology**
- **Psychology**

Human Factors

1. Physiology - Study of human body physical functions, abilities, processes, and reactions.

Human Factors

Physiology in Aviation

- **Pilots:** The human body was developed to be a land-based creature.
- **Helicopter Mechanics:** Often work in unimproved maintenance settings and in all climatic conditions.

Consequently, pilots & mechanics must understand how the human body will perform in those environments.

Fatigue

- Longer work hours and commutes home
- Fewer maintenance personnel & aircrews
- Affects emotional, physical & mental capabilities
- Causes performance decline similar to alcohol
- Alertness not normally given it due importance

Fatigue & Alertness Solutions

- Adjust shift rotation patterns, worker schedules and local circumstances
- Seek expert help to train workers regarding fatigue & alertness awareness
- Consider fatigue when investigating an accident or incident
- Comply with your national aviation authority's fatigue regulations

Human Factors

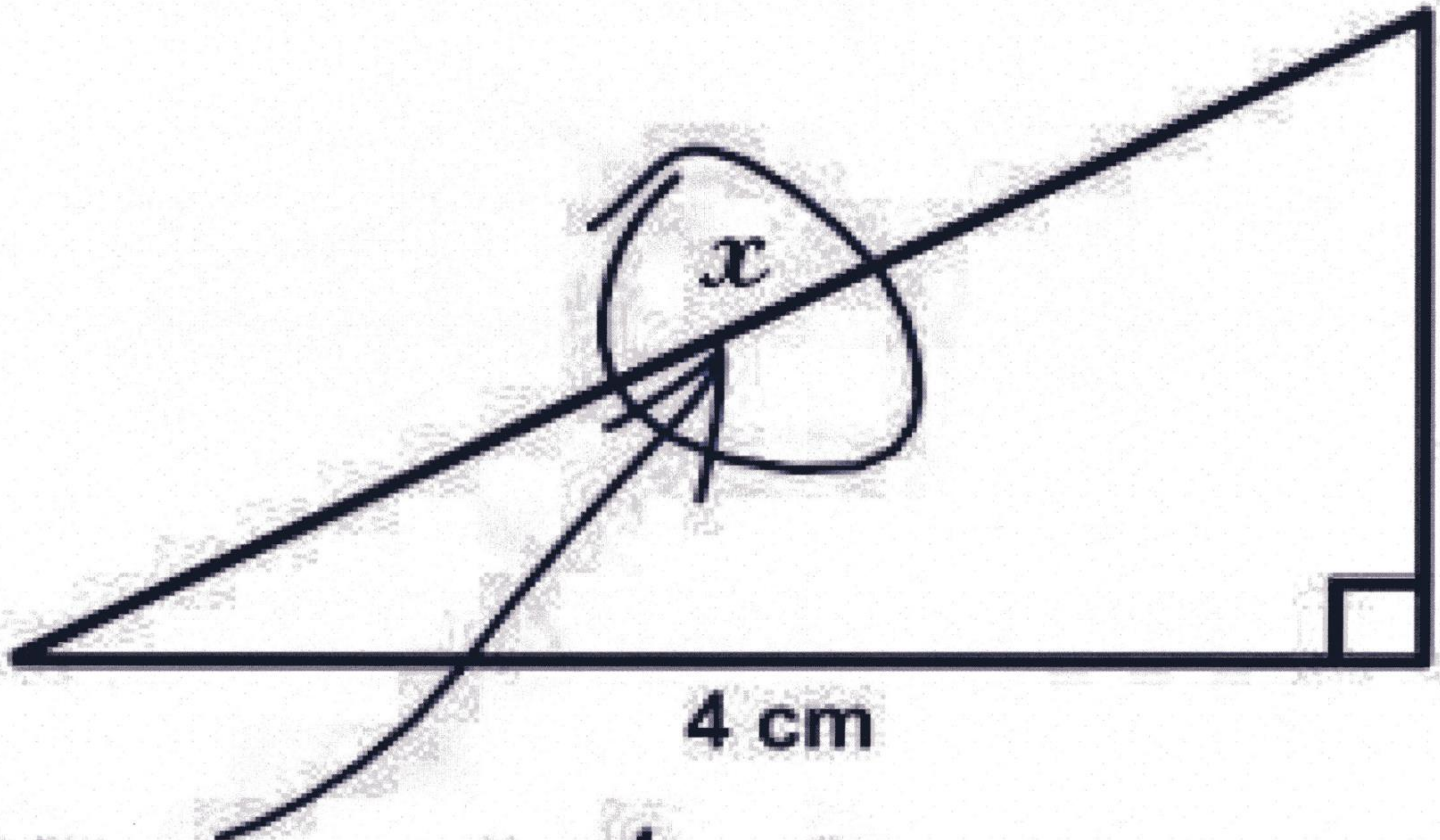
2. Psychology

The study of how humans think. An analysis of the factors that affect our decision making.

Psychology in Aviation

Mechanics and pilots need to understand that many factors affect Decision Making before and during Flight.

3. Find x.



Here it is

Its All About Judgment

Ergonomics

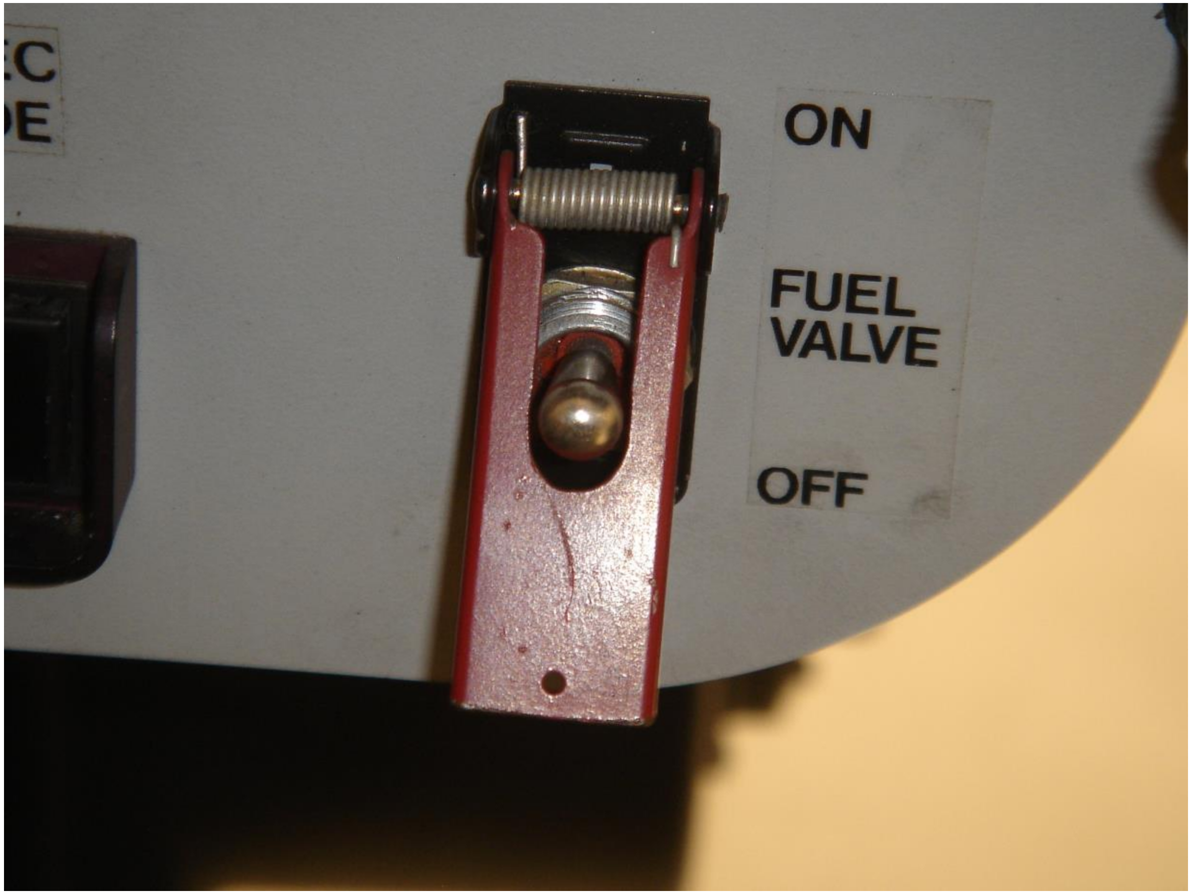
The study of the relationship between the Human and the Things used to do work.

Ergonomics

Ergonomics is generally a Designer's function

- The design of an aircraft and its systems affects the performance of those who fly and maintain them.

Poor ergonomic designs may allow errors.


ON
FUEL
VALVE
OFF

Good Teamwork?

How Personality Can Affect Mechanics and Pilots

Many incidents are influenced by a failure or a weakness of **Personal Skills** - things like **Communications, Teamwork, Authority, and…**

Assertiveness

Assertiveness is:

The ability to voice one's concern and / or to take action when needed

Basic Natural Disposition

- Each person develops a predominant style of dealing with others
- Passive, Aggressive, or Assertive
- Commonly accepted that Assertiveness is desired in aviation
- Being a <u>mechanic</u> or <u>pilot</u> does not change a person’s natural disposition – you are who you are

Barriers to Assertiveness

1. Submission to Authority

2. Lack of Knowledge or Confidence

3. Fear of Punishment

4. Excessive Professional Courtesy

1. Submission to Authority

- Everyone knows their boss / superior
- Everyone recognizes their position of authority and responsibility
- This chain of command can be as obvious as an insignia of rank
- Blind obedience to a superior may be a mistake
- Superiors often need help in making decisions and taking proper action

2. Lack of Knowledge or Confidence

- Complete ignorance - Can result in failure to act or speak up
- Uncertainty - Can result in doubt, hesitation, and reluctant actions or statements
- Knowledge - Can result in positive, confident actions and statements

3. Fear of Punishment

- Early lessons to us were to be quiet, respect elders or leaders, don't talk back, obey the rules…or else!
- Violations drew admonishments or punishments
- Those lessons carry into adulthood and into the hangar and cockpit
- But this fear must be disregarded when safety is at stake

4. Excessive Professional Courtesy

- Another early lesson was to be courteous to elders
- Tendency for a junior to concede that a senior “Knows his Stuff”
- Junior will overlook things with a senior that he would not with another peer
- Courtesy may have to be sacrificed when safety is at stake

Foresee the Need for Assertiveness

- Think about past situations you are likely to encounter again
- Develop your position ahead of time

Lots of Examples, let's look at only two…

Example 1

How would you handle an unsafe, unusual or unacceptable request to speed up a detailed inspection in order to meet a schedule?

Example 2

How would you as a pilot handle an unsafe ATC instruction?

Foresee a Need for Assertiveness

- When prepared, you will be better able to assertively and confidently handle those situations
- Recognize that you may need to be assertive with yourself.

For more information go to:

www.heliprops.com

THANK YOU

Safety Culture

Wg. Cdr. (Retd.) B. S. Singh Deo, VM

VP – RWSI

Kathmandu, 30 August, 2024

What is SAFETY?

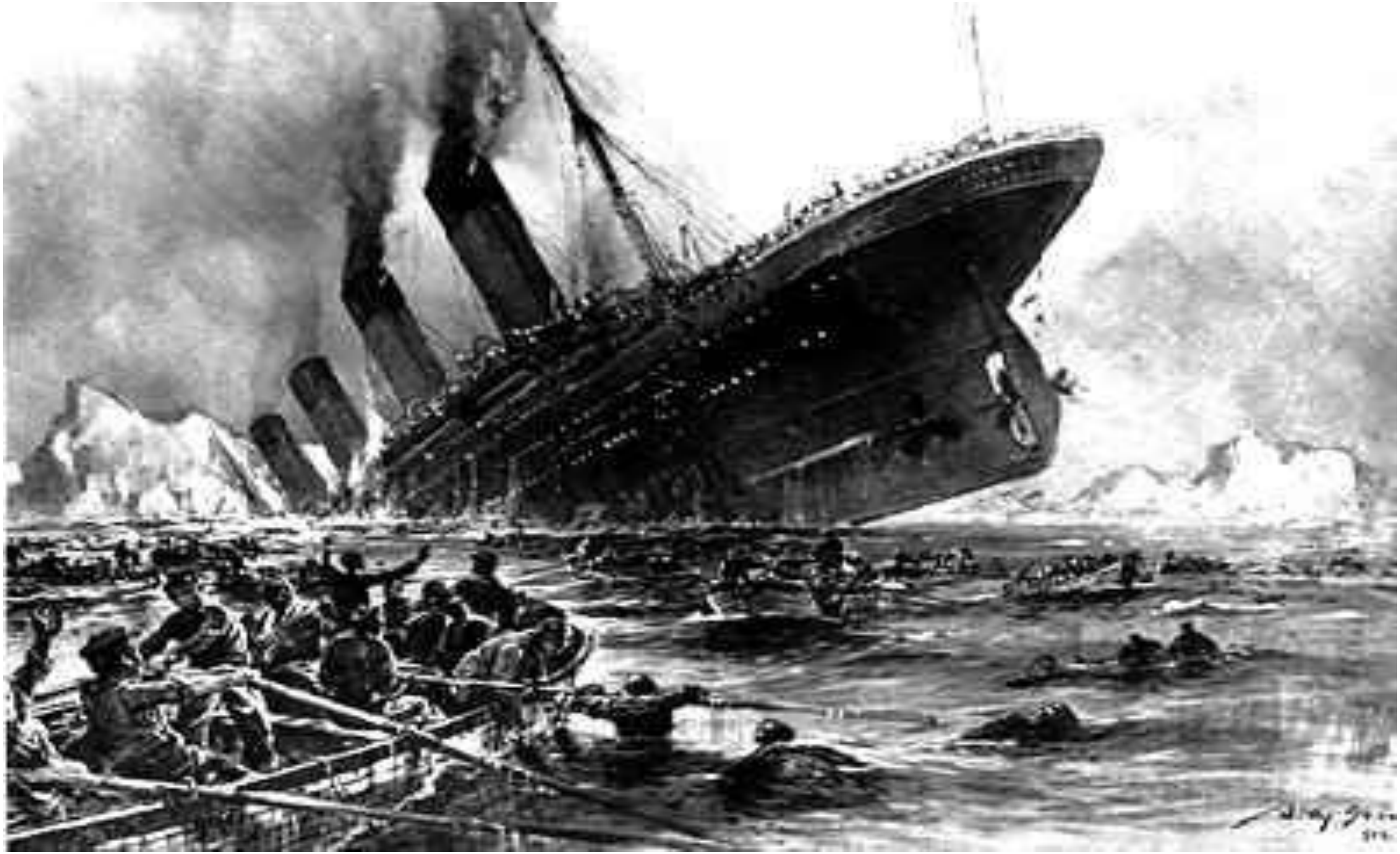
Safety is MANAGING RISK

How safe is safe enough?

"When anyone asks me how I can best describe my experience of nearly forty years at sea, I merely say, **uneventful**. Of course there have been Winter gales, and storms, and fog, and the like, but in all my experience I have never been in an accident of any sort worth speaking about. I have seen but one vessel in distress in all my years at sea….. I never saw a wreck and never have been wrecked, nor was I ever in any predicament that threatened to end in disaster of any sort."

- Capt. E. J. Smith in a seminar over 100 years ago!

The Titanic Disaster – 14 April, 1912



Why Accidents Happen

- UNSAFE CONDITIONS
- UNSAFE PRACTICES

Why Titanic Sank?

- 7 iceberg warning messages that day, but ignored.
- Key to Binocular box misplaced – SOP violated.
- The ship was considered unsinkable – over-confidence.
- Cruising too fast for the size of that ship.
- Tried to avoid the iceberg – SOP said crash head-on.
- The "Californian" warned the Titanic of icebergs 19 miles ahead. But the Titanic radio operator was annoyed, said - "Shut up, shut up. I'm busy".

The Boats

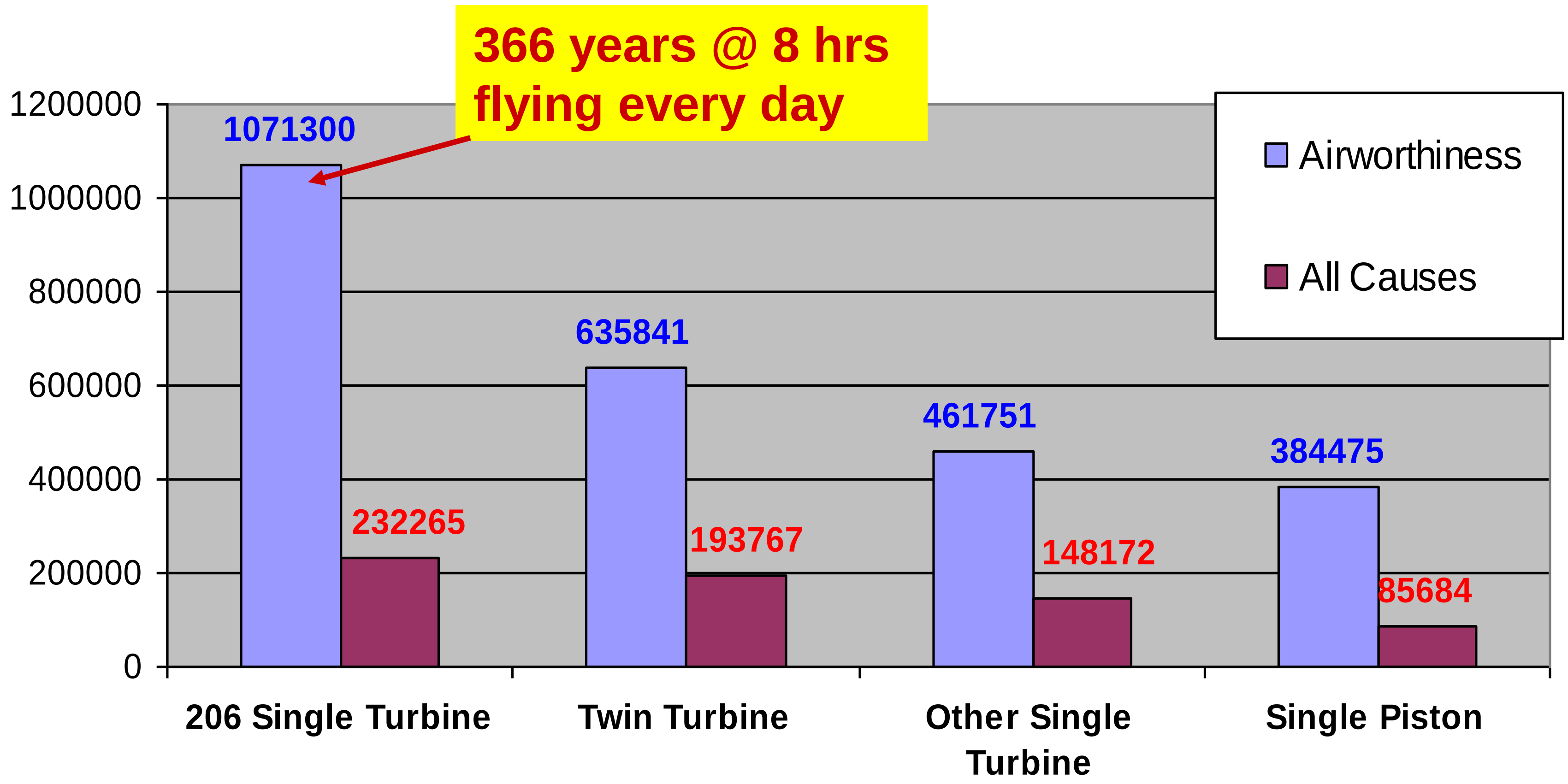
Originally, *"Titanic"* was designed to carry 66 lifeboats, enough for everyone on board. It was feared that passengers could become uneasy about the safety of the new gigantic liner…………, so *"Titanic"* was outfitted with *only 20 lifeboats*.
(The rules required only 16!)

UNSAFE CONDITIONS

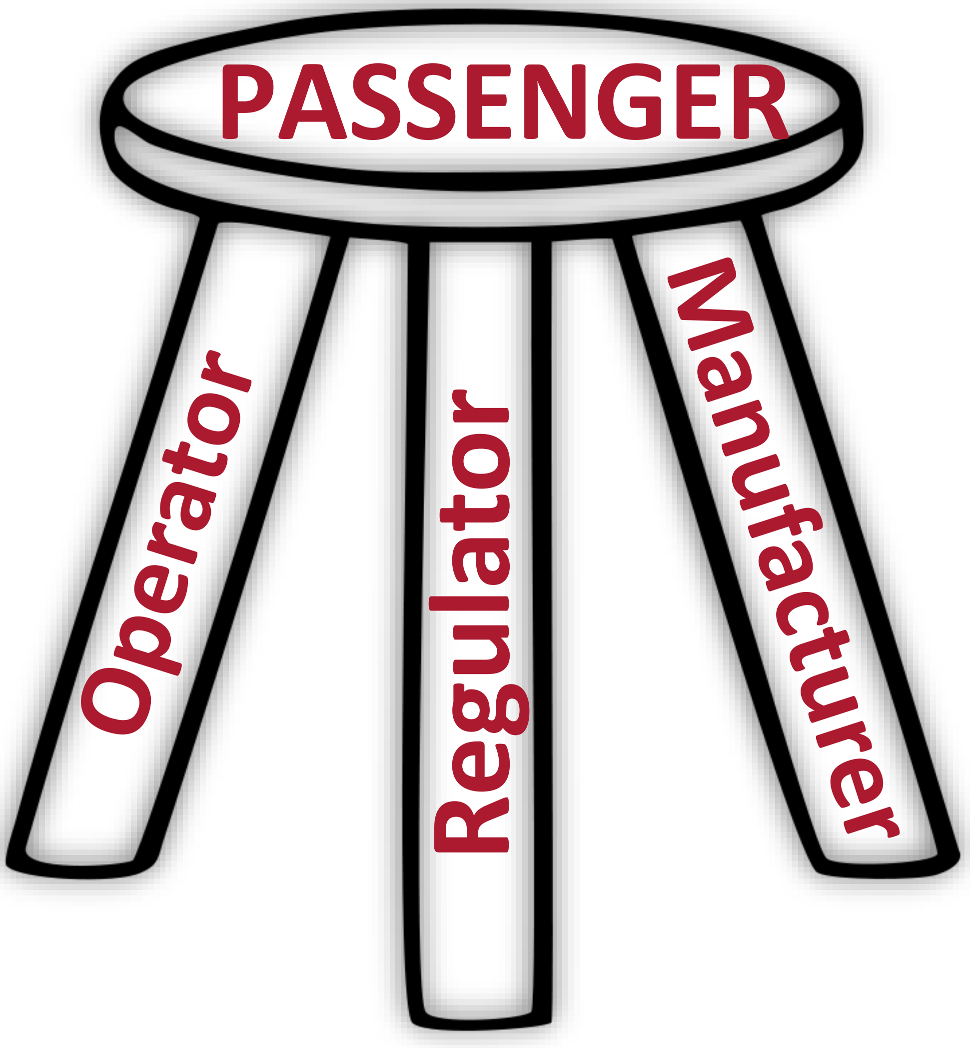
Lack of SHARED VISION

LETS TALK AVIATION

Occupant Flight Life Span : Mean Flight Hours Before Fatal Injury



Who is responsible for Safety?



Story of the B-17 Flying Fortress, the then most sophisticated airplane

30 December, 1935

On that day Boeing was set to introduce the B-17 *Flying Fortress*. Boeing's Chief Test Pilot and a company mechanic accompanied the flight crew. On the ground, an eager audience watched as the magnificent machine raced down the runway. It lifted off, began to climb, and seconds later, crashed.

The cause? The flight crew had failed to disengage the gust locks!

<u>National Checklist Day – 30 December</u>

Aircraft complexity had now outstripped the memory capacity of humans, the company created a checklist and made its use mandatory.

Use of checklists expanded from flight crews to other aviation functions, and its success as an aviation safety tool carried the concept into numerous other industries.

Same Concept, Shifting Forms

The basic checklist concept started 89 years ago and use of this critical tool has greatly improved. The checklist of the yester years compared to today's general aviation (GA) glass cockpit airplanes, there is a world of difference.

But we continue to argue about "proper" or "correct" ways to do things. There are discussions about the "right" way to use a checklist. Here are the contenders:

Same Concept, Shifting Forms

- 🛩️ ***Challenge-and-Response:*** Professional flight crews use challenge and response. In this model, the pilot monitoring (PM) reads an item on the checklist (the challenge). The pilot flying (PF) responds by taking the required action, and the PM verifies that the correct action was indeed taken.

- 🛩️ ***Review-and-Do:*** This method is for activities like pre-flight inspection, engine start, and pre-taxi.

- 🛩️ ***Do-and-Review:*** Perform the action and use the checklist to verify that you completed all listed items.

- 🛩️ ***Go-with-a-Flow:*** This one — possibly just another name for do-and-review — advocates using logical and consistent flow patterns to accomplish all necessary tasks, with the printed document as a backup. Using mnemonics (e.g., CIGARS for pre-takeoff checklist) is consistent with this method.

Which one is the best?

- “none of the above” (because each has limitations)
- “all of the above” (because each has its strengths)
- Not using a checklist at all! The only wrong answer

FOLLOW COMPANY POLICY

Evolution of Safety Culture

- 30 Oct 1935 – World Checklist Day
- Era of SOPs
- Safety through Training
- Safety through Technology
- Safety through AI???

Anticipated Factors Causing Accident Rate Reductions (IHST)

2006 - 2008

More accurate flight hours

Safety Awareness
-IHSS 2005, 2007
-Articles, Annual JHSAT Reports, JHSIT Toolkit (SMS)
-Talks
-High Interest
- SMS Training (JHSIT & ALEA)

Safety Culture

2009 - 2015

More accurate flight hours

Safety Awareness
-IHSS Bi-Annuals
-Articles, Talks, JHSAT Reports, JHSIT Toolkits (SMS, Training, Risk Assessment, FDM, etc.)
Safety Culture

End User Demand
SMS Training
Flight Training

Other Mitigations
Pilot Aids: Active Proximity Warnings, HTAWS, Enhanced Vision, Flt Following

Recording Devices
Flight Data Monitoring

2016.....

More accurate flight hours

Safety Awareness
-IHSS bi-annual Meetings
-JHSIT Toolkits, Articles

Safety Culture
SMS Training
Flight Training

End User Safety Pull

Other Mitigations &
Pilot Aids: Active Proximity Warnings, HTAWS, Enhanced Vision, Flt Following

Recording Devices
Flight Data Monitoring

2016 and Beyond….

- ADS-B
- HTAWS (EGPWS)
- WAAS and LPV
- HUMS
- Enhanced Vision System
- Night Operations with NVG
- PBN
- Safety Through Technology - Unknown and Unknowable!

BELIEVE IN

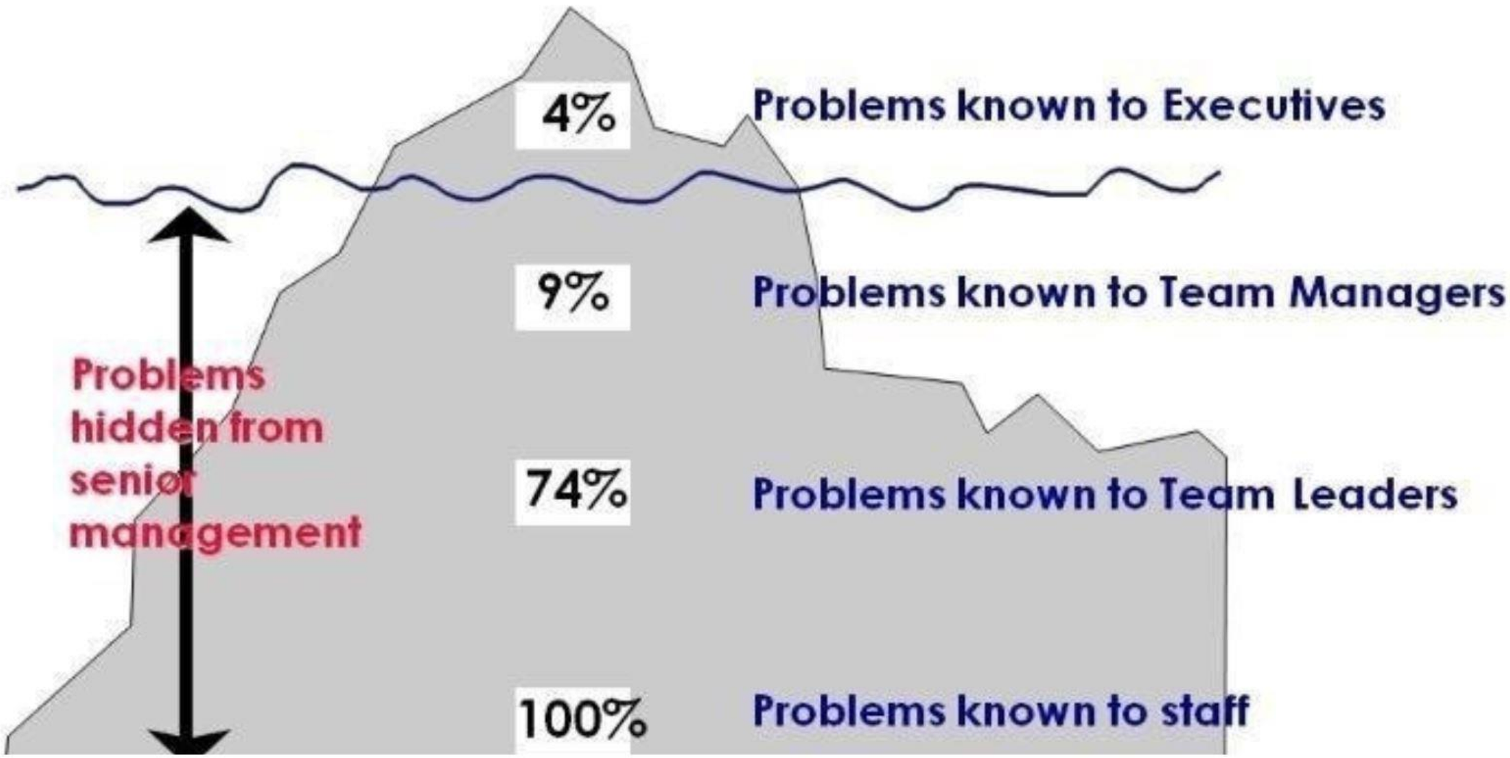
SAFETY THROUGH EDUCATION & TRAINING

Safety Through Education

- SMS Training
- CRM Training
- Spl VFR Training
- Human Factors Training
- Mountain Operations
- Avoiding Wire Strikes

Learn from <u>ALL</u> Operations Vs Only from Mishaps

Learn from ALL Operations



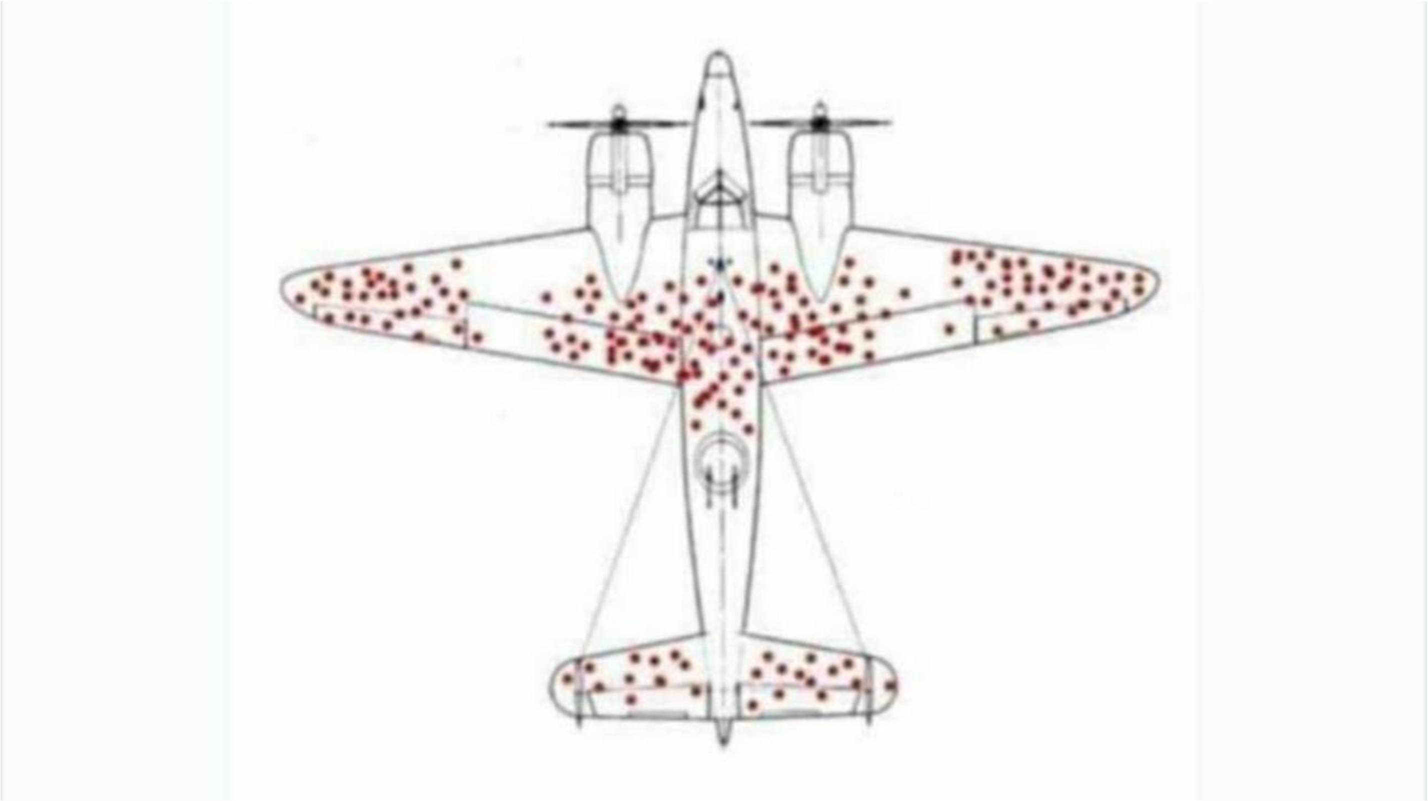
The Iceberg of Ignorance

Learn from ALL Operations

Always Remember

Safety First ✓

Survivorship Bias - Bullet Holes on Allied Aircraft in WW-2



Learn from ALL Operations

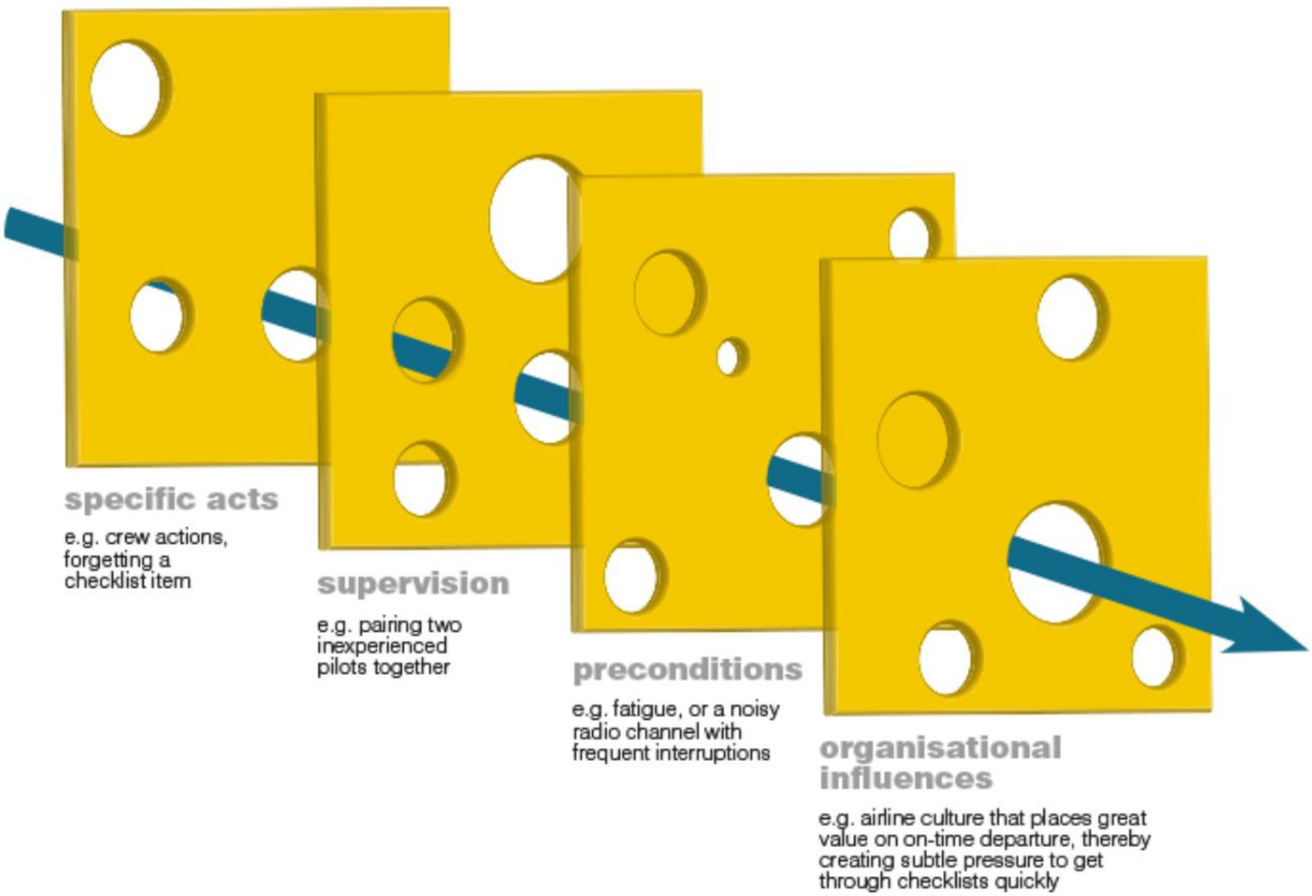
Aviation is the Safest Mode of Travel…

BUT

What is Culture?

"Customs, Ideas, **Beliefs**, etc. of a particular society, country etc."

The Swiss Cheese Model



“CULTURE EATS STRATEGY FOR BREAKFAST”

Some Cultural Issues

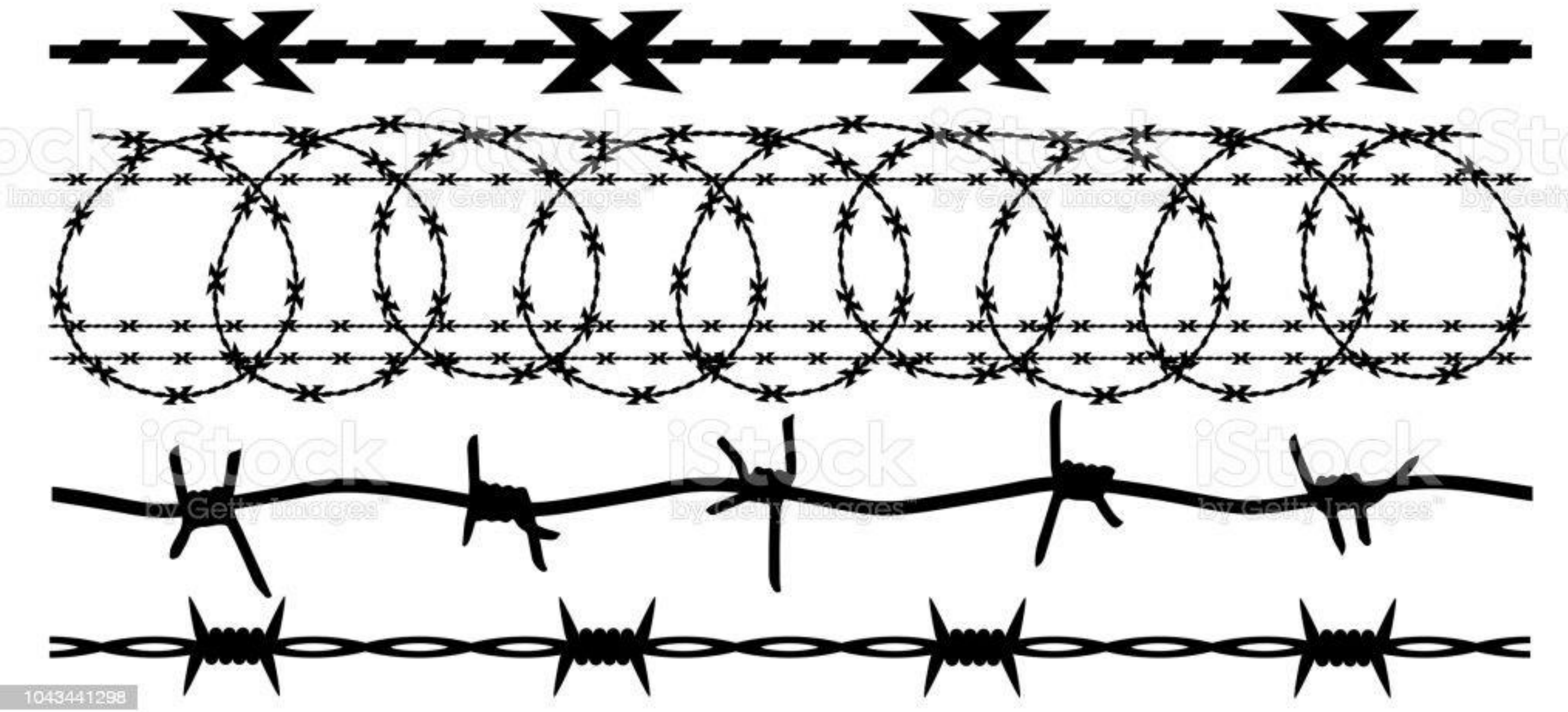
1. Misuse of Safety Net

2. Normalisation of Deviance

The ever present SAFETY NET

The A. P. Govt. Bell 430 Accident

The IDEAL SAFETY NET



Normalisation of Deviance – The Root Cause

Root Cause is arrived at by 5 WHY exercise-

1. WHY
2. WHY
3. WHY
4. WHY
5. WHY

= RESULT

Space Shuttle CHALLENGER
28 January, 1986

Space Shuttle COLUMBIA
1 February, 2003

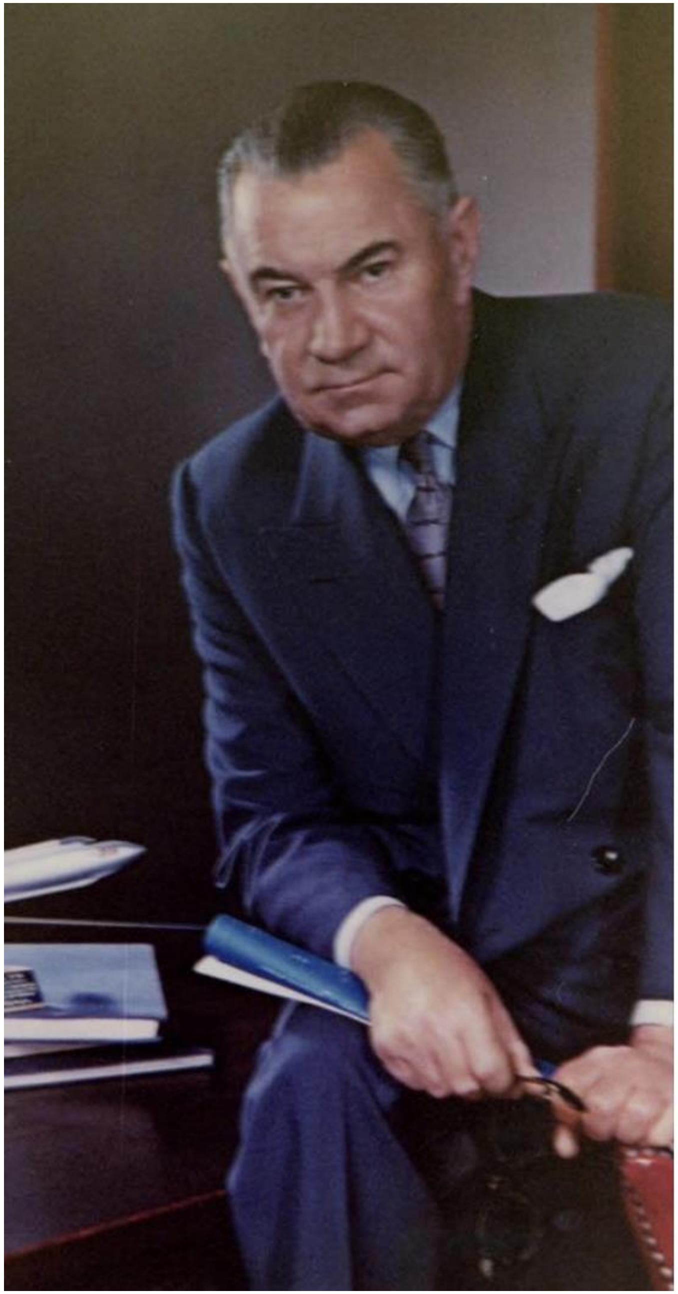
Challenger Accident Investigation

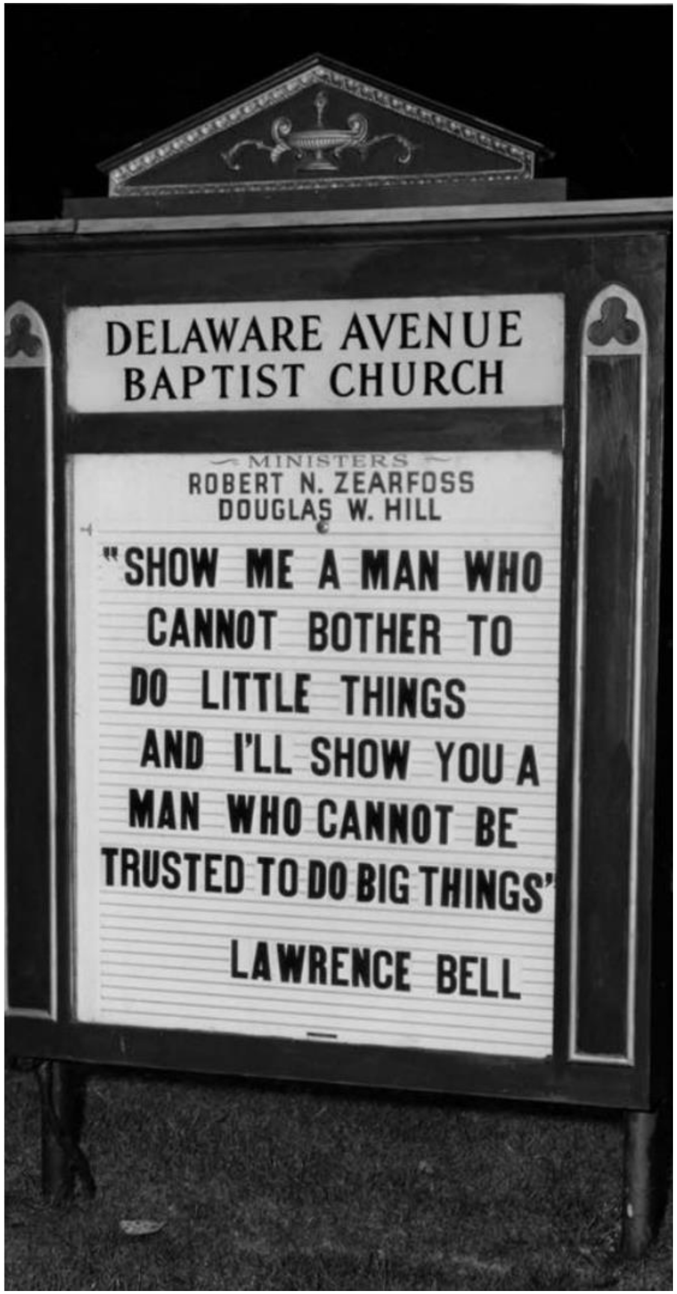
Lesson Learned: ***Well-intentioned people and high-risk organizations can become desensitized to deviations from the norm***

This is called "Normalization of Deviance", a major factor in Columbia and Challenger disaster -

- **"Unexpected becomes the expected which becomes the accepted"**
- **Small anomalies may be symptomatic of larger problems - failure to address could be disastrous**
- **System effects take years to develop and cause failures!**

The **Culture** of your organization is shaped by the **worst behavior** your leaders are willing to tolerate.




DELAWARE AVENUE
BAPTIST CHURCH
MINISTERS
ROBERT N. ZEARFOSS
DOUGLAS W. HILL
"SHOW ME A MAN WHO
CANNOT BOTHER TO
DO LITTLE THINGS
AND I'LL SHOW YOU A
MAN WHO CANNOT BE
TRUSTED TO DO BIG THINGS'
LAWRENCE BELL

RISK PRIORITY EXCERCISE

Failure Mode & Effect Analysis

	FIRE INCIDENT IN KITCHEN				
	FAILURE MODE	(A) OCCURRENCE Probability Rate 1-10 10 = Highest Probability	(B) DETECTION Probability Rate 1-10 10 = Lowest Probability	(C) SEVERITY Rate 1-10 10 = Most Severe	RISK PRIORITY NUMBER RPN A x B x C
1	Dress Catches Fire				0
2	Dress Catches Fire				0

THANK YOU

BACK TO BASICS

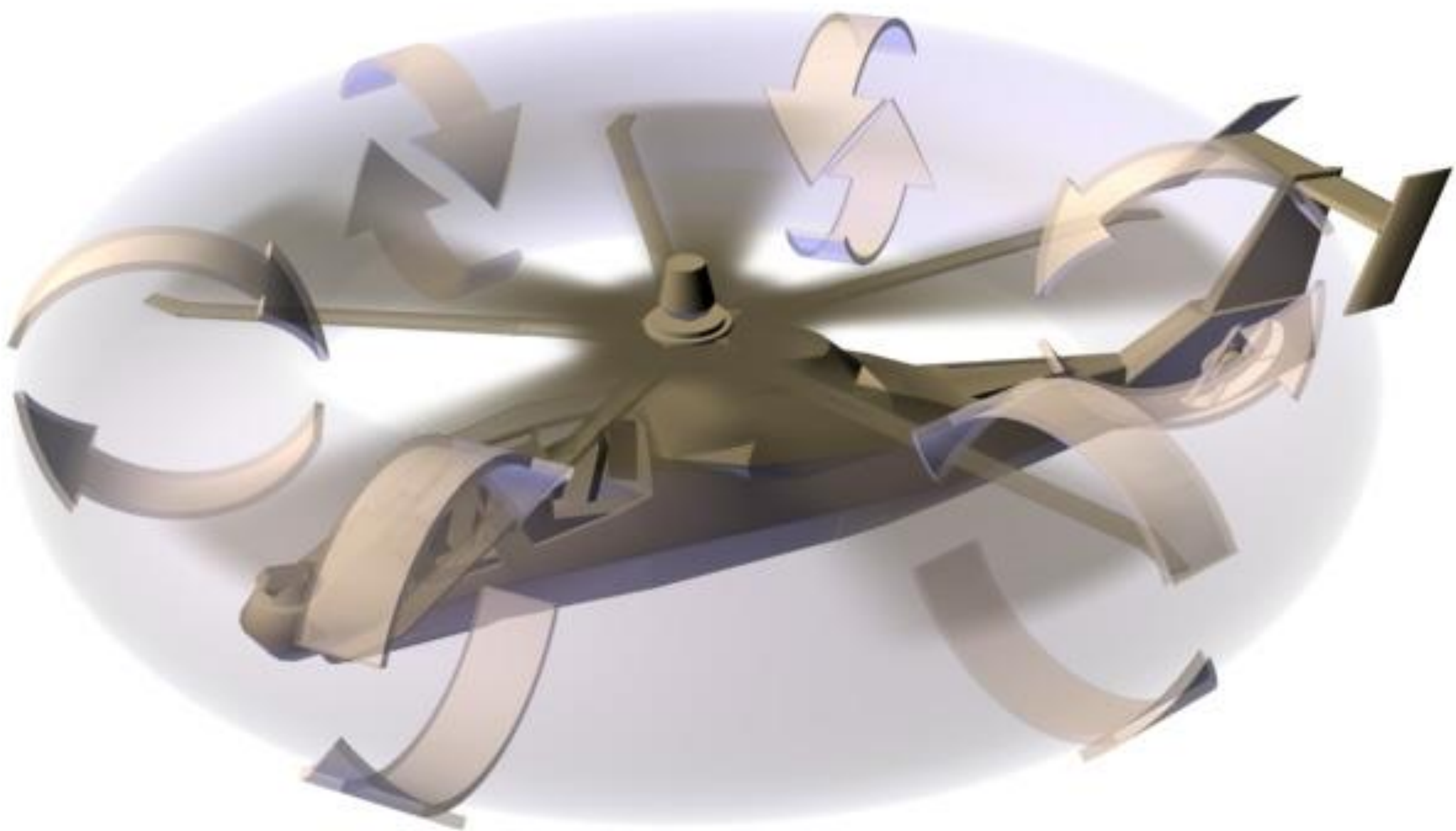
OF

HELICOPTER AERODYNAMICS

By

Wg. Cdr. B. S. Singh Deo, VM (Retd.)

VORTEX RING STATE

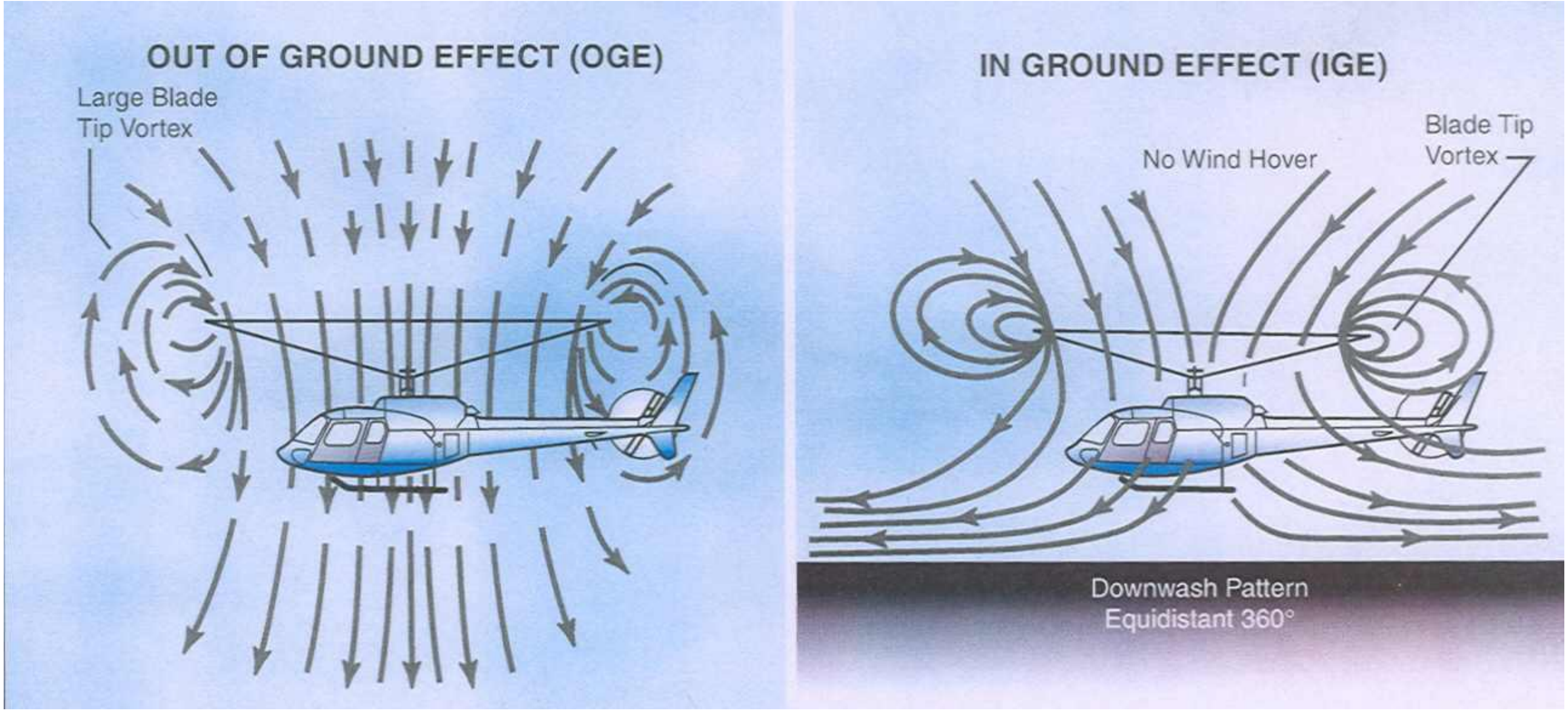


VORTEX RING STATE

Is an aerodynamic condition where a helicopter is in a vertical descent (in Air) with up to maximum power applied, and little or no cyclic authority.

Settling with Power is a name associated with VRS

Airflow in OGE & IGE Hover

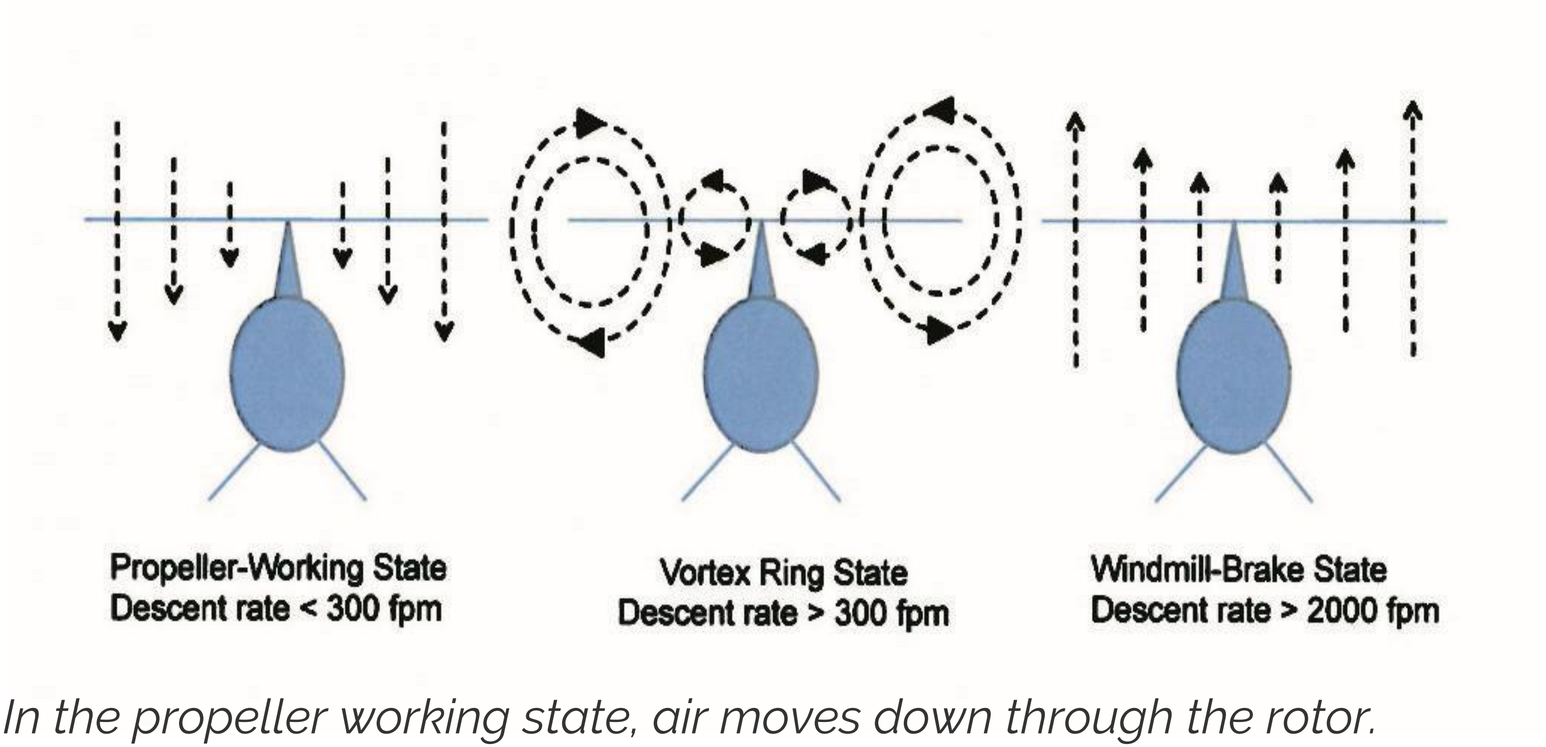


Aerodynamics of VRS

- Tip Vortices – consume engine power but provide no lift
- Effect of small tip vortices in normal OGE hover is negligible
- Vertical descent increases tip vortices and leads to vortex ring state

WISH TIP VORTICES WERE VISIBLE!

Aerodynamics of VRS



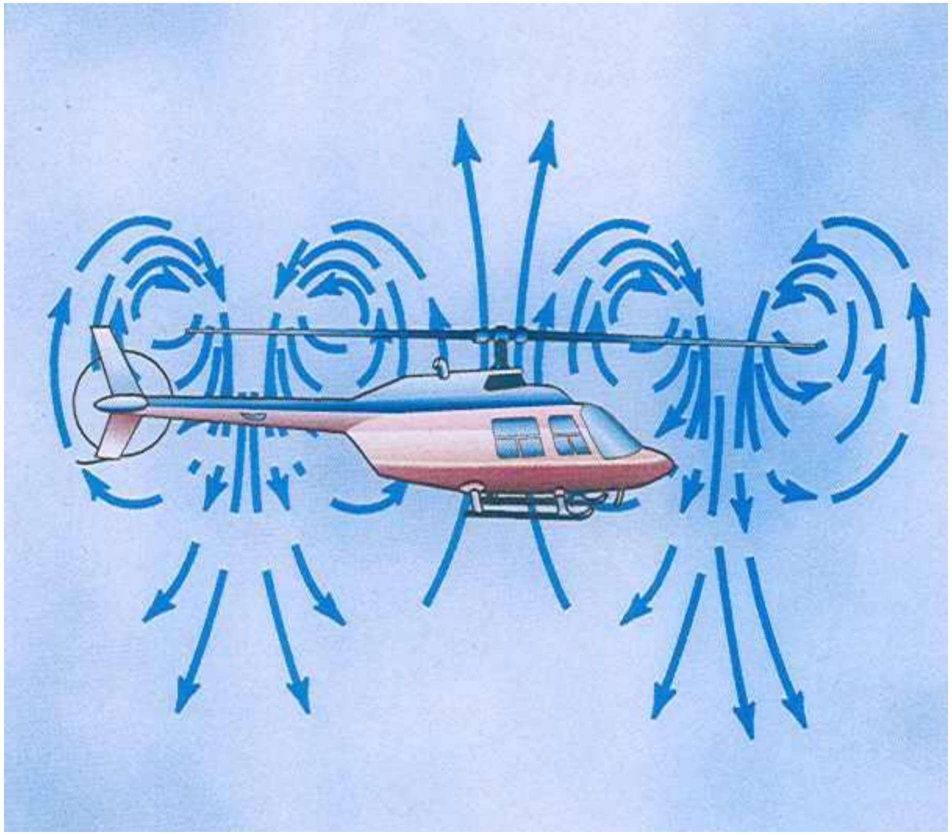
1. *In the propeller working state, air moves down through the rotor.*

2. At a descent >300 fpm, vortex ring state begins; some down flow moves radially out under the rotor disc and is drawn up and into the rotor.

3. In the windmill brake (autorotative) state, all air moves up through the rotor.

LOOK OUT FOR THE HOLE IN THE FLIGHT ENVELOPE!

Airflow in VRS



VRS – Effect on Controllability

- In a vortex ring state, most of the power developed by the engine is wasted in accelerating the air in a doughnut pattern around the rotor.
- The helicopter may descend at a rate that exceeds the normal downward induced-flow rate of the inner blade sections.
- The airflow of the inner blade sections is upward relative to the disc. This produces a secondary vortex ring in addition to the normal tip-vortices.
- The secondary vortex ring is generated about the point on the blade where the airflow changes from up to down. The result is an unsteady turbulent flow over a large area of the disc.
- Rotor efficiency is lost even though power is still being supplied from the engine.

Wind Tunnel Picture of VRS

Conditions for VRS

1. A vertical or nearly vertical descent of at least **300 feet per minute**. (Actual critical rate depends on the gross weight, r.p.m., density altitude, and other pertinent factors.)

2. **Power On** flight (from 20 to 100 percent).

3. The horizontal velocity must be **below transition speed.**

Flight Conditions conducive to VRS

- Attempting to hover out of ground effect at altitudes above the hovering ceiling of the helicopter

- Attempting to hover out of ground effect without maintaining precise altitude control

- Downwind and steep power approaches in which airspeed is permitted to drop to nearly zero.

Hole in the Flight Envelope is Lurking Nearby

Indications of VRS

A fully developed vortex ring state is characterized by:

- An unstable condition where the helicopter experiences un-commanded pitch and roll
- Has little or no cyclic authority
- Descent rate as high as 6,000 fpm
- Accompanied by increased vibrations

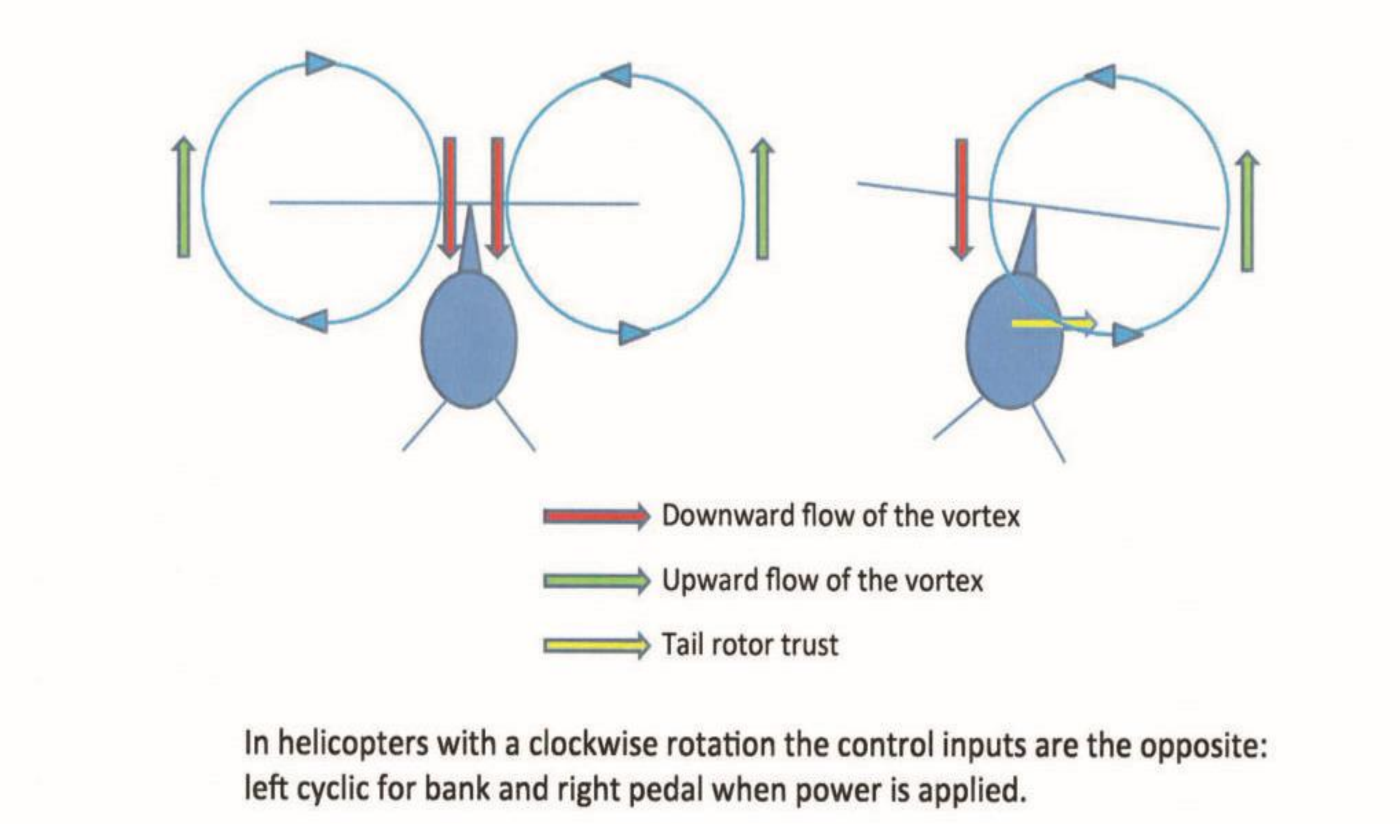
VRS takes you out of the normal flight envelope!

Recovery Techniques

- Increase forward speed, and/or partially lower collective pitch.

- Enter autorotation to break the vortex ring state. When cyclic authority is regained, you can increase forward airspeed.

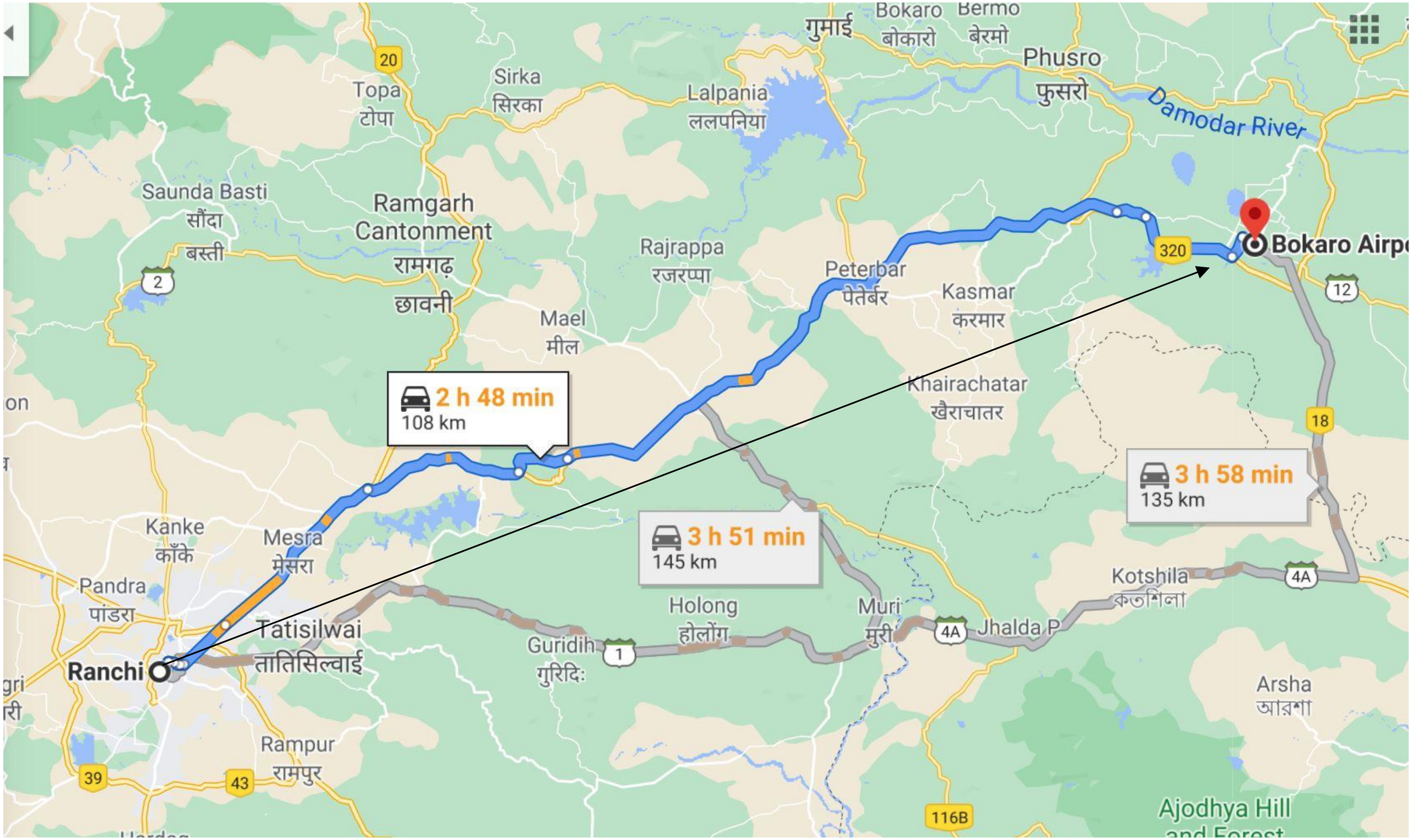
The Vuichard Recovery Technique



Induce sideways movement in the direction of the Tail Rotor Force followed by lowering of collective.

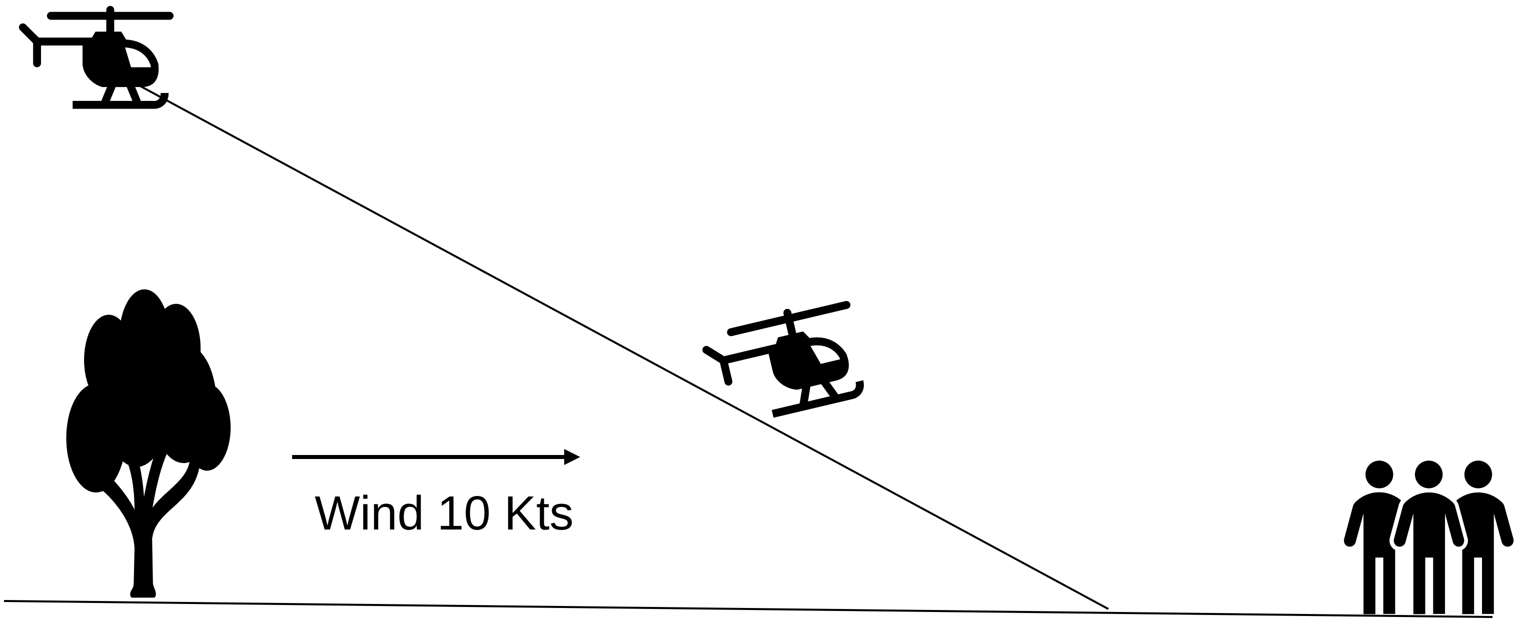
https://youtu.be/dW8gCfBcIW0

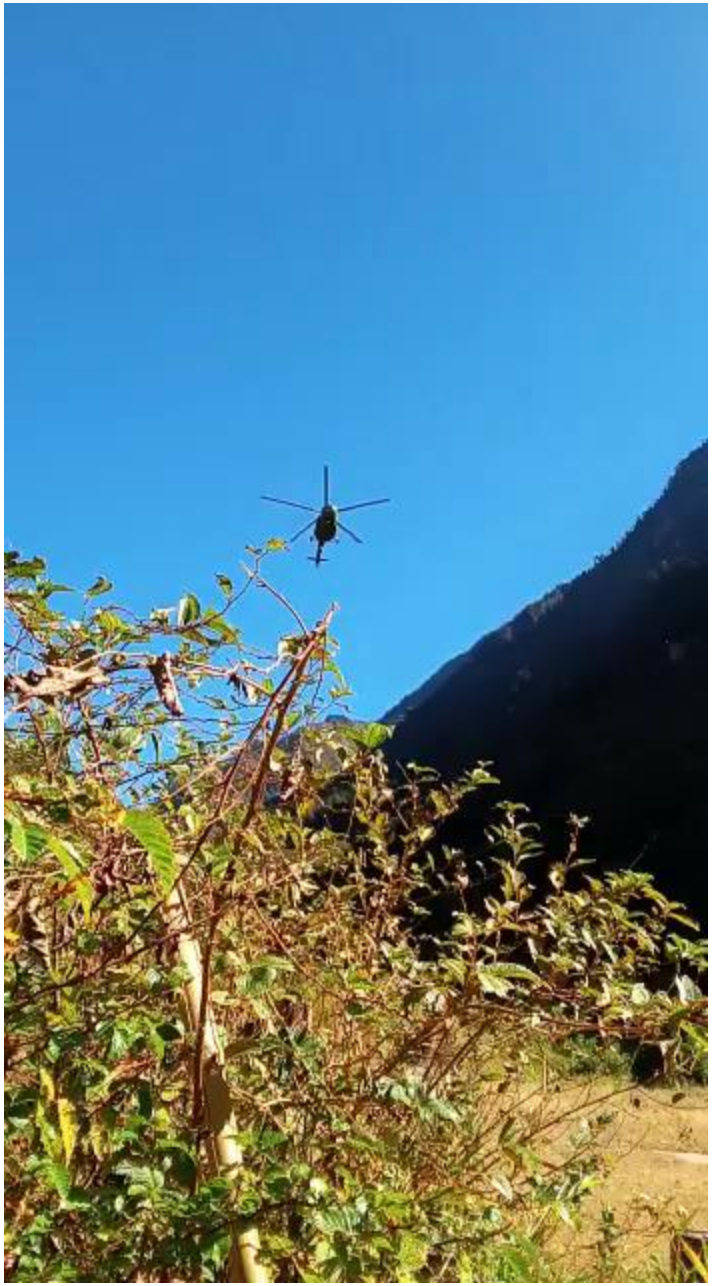
Bell 407 Accident in Bokaro Due to VRS



Runway 13/31

VRS on Short Finals





LTE - Loss of Tail Rotor Effectiveness

LTE

Un-anticipated and un-commanded yaw rate that does not subside of its own, and if not corrected, can cause loss of control of the helicopter - is called **Loss of Tail Rotor Effectiveness.**

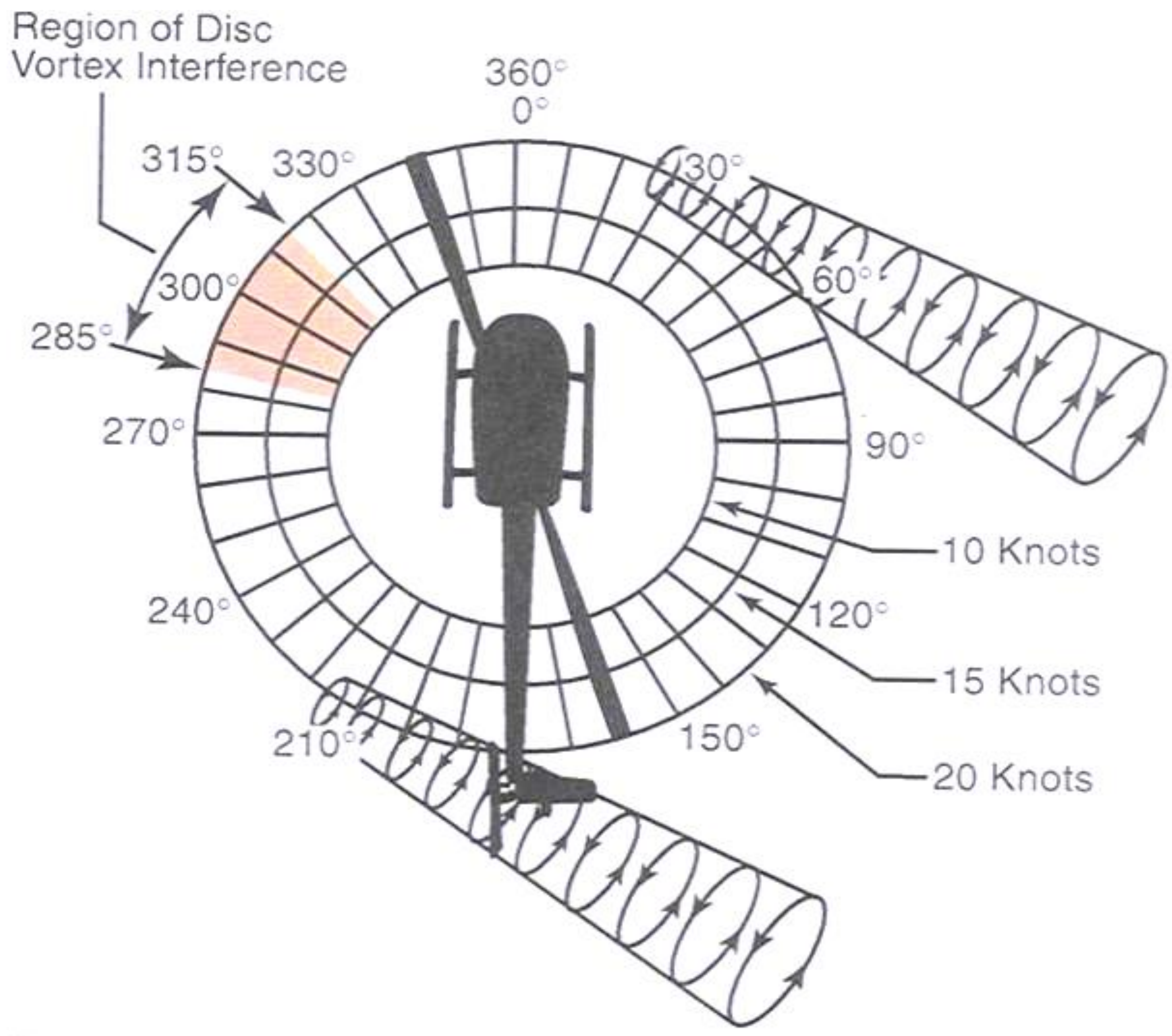
LTE increases pilot workload and diverts attention

Aerodynamics of LTE

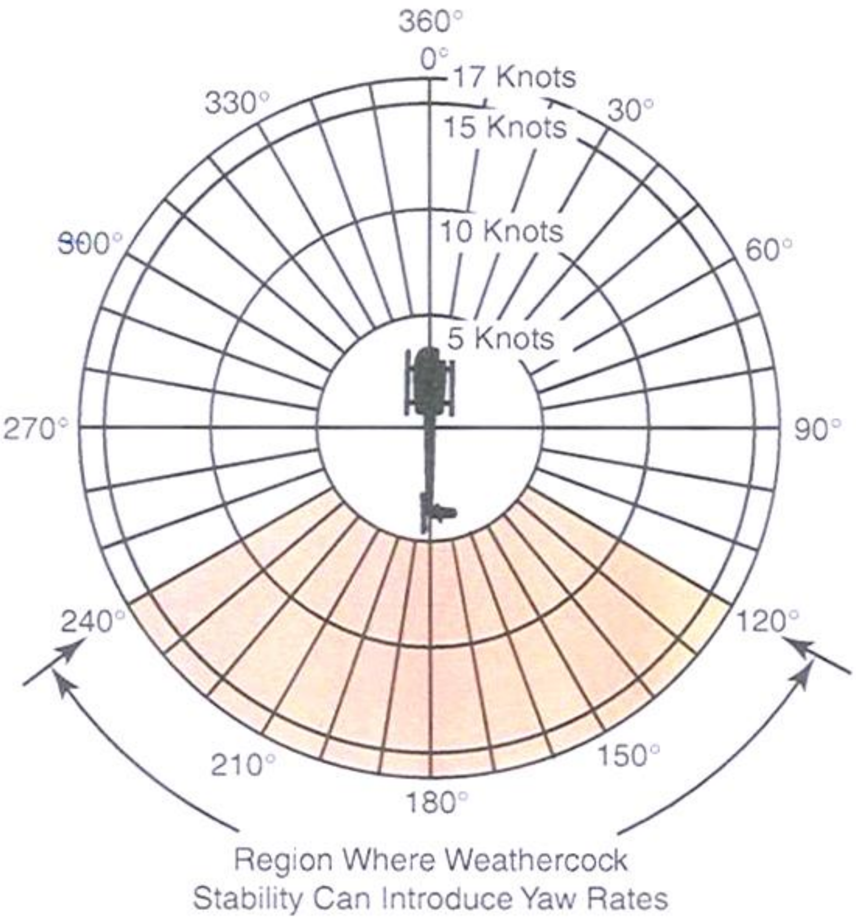
1. Main Rotor Disc Interference
2. Weathercock Stability
3. Tail Rotor VRS

LTE is NOT a Malfunction but is Aerodynamic in nature

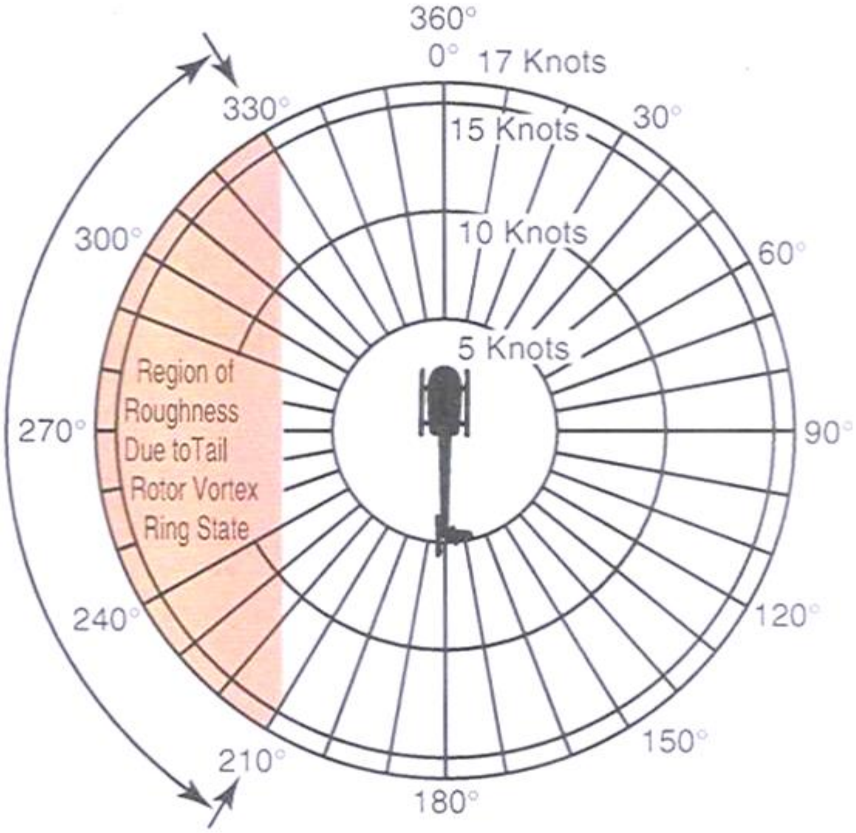
Main Rotor Disc Interference



Weathercock Stability



Tail Rotor VRS



Right Yaw will lead to Tail Wind Condition!

Avoiding LTE

- Maintian full rotor rpm
- Avoid tail wind condition
- Careful in OGE hover with full load
- Be aware of wind direction between 8 – 12 kts
- When pedal trim is more to left, less reserve is available (anti-clockwise rotor turning)
- Careful in gusting wind conditions

LTE Accident

https://www.youtube.com/watch?v=4dB5Ak80l-8

LTE Accident - 2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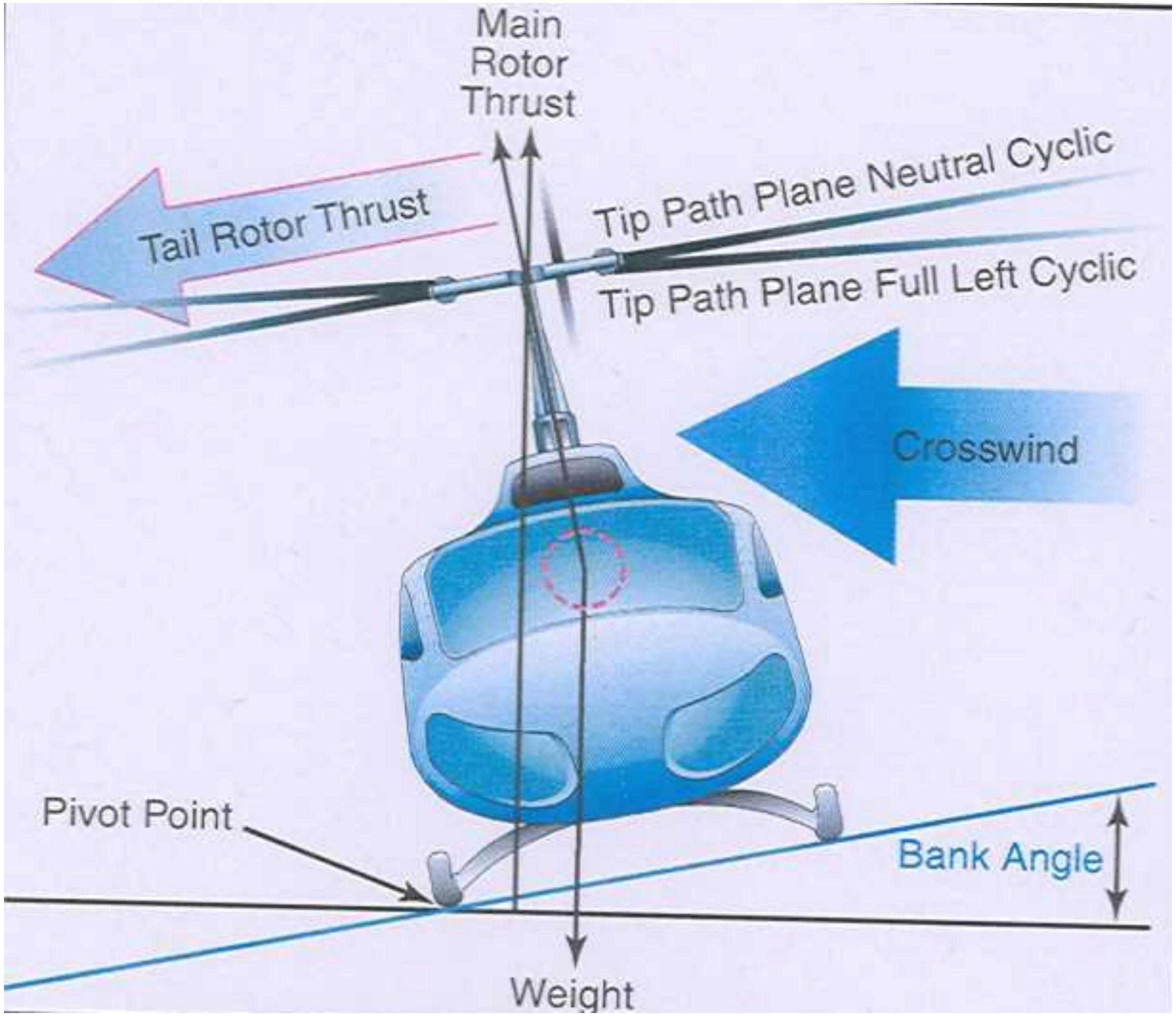
DYNAMIC ROLLOVER

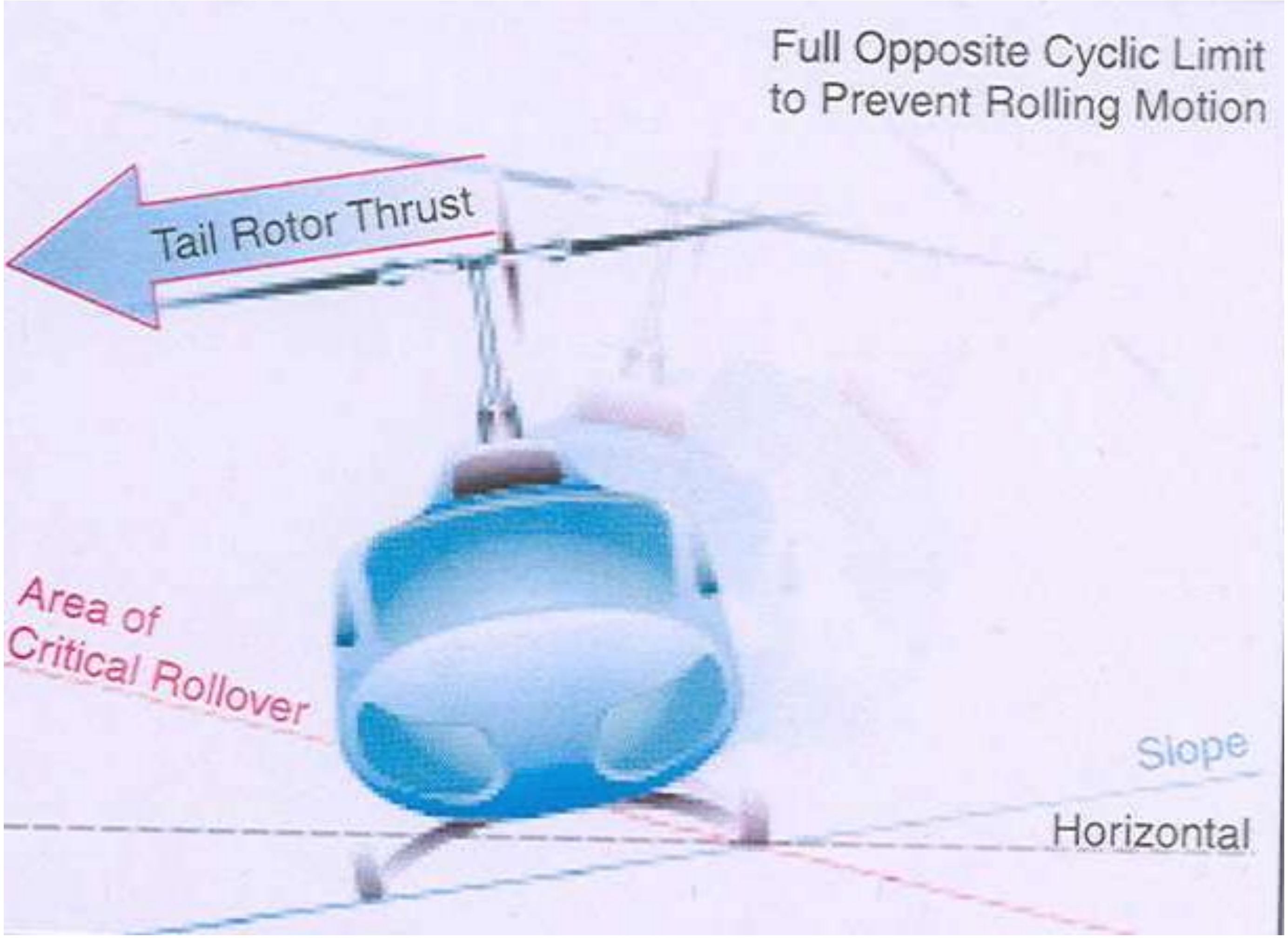
Definition

Dynamic Rollover occurs while in contact with the ground and a roll is caused beyond a critical angle after which a recovery is not possible.

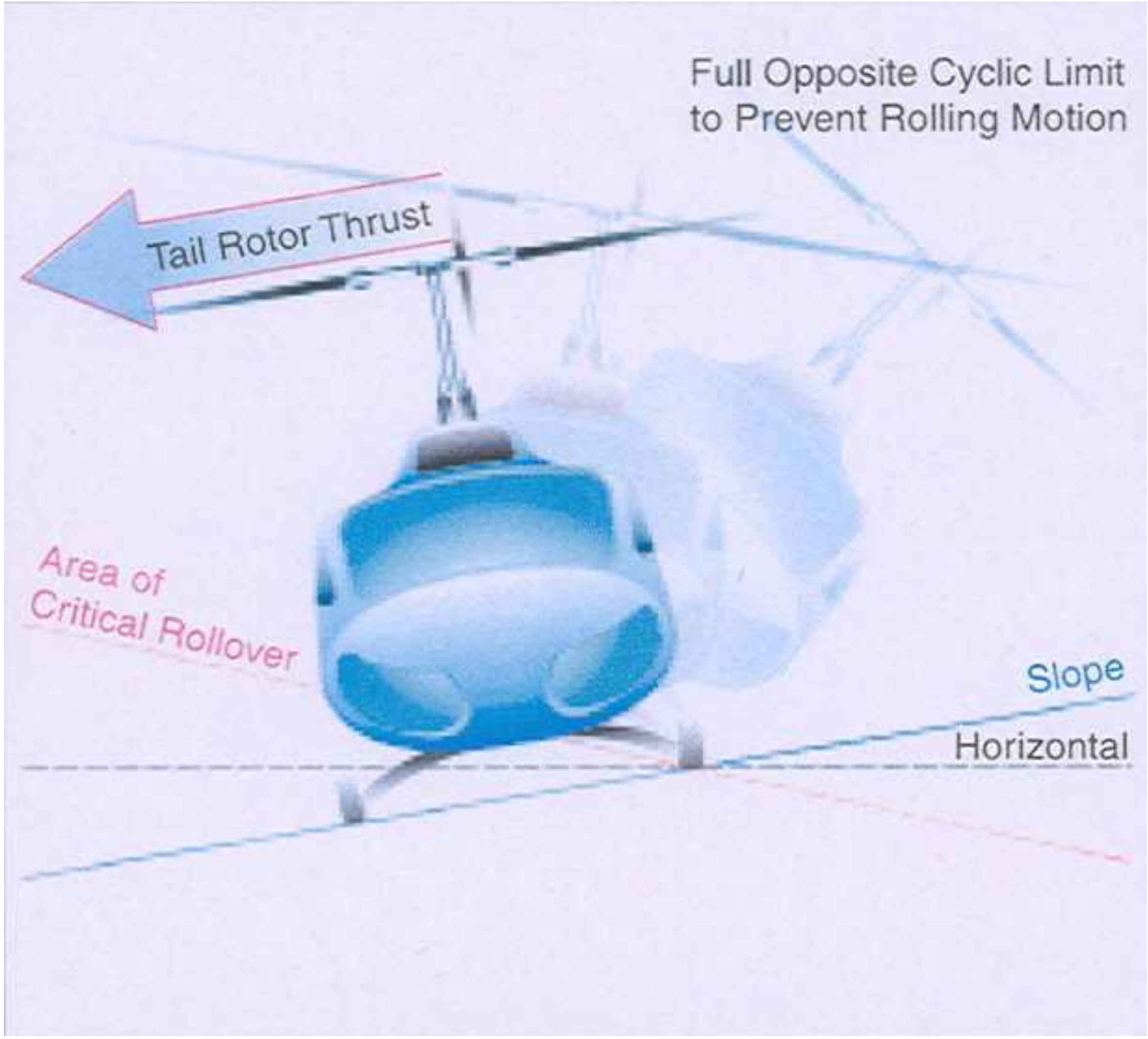
Case 1 - Crosswind



Case 2 – Sloping Area



T/R Translation causes roll



Critical Conditions

- Right side skid/wheel down, since T/R translating tendency adds to the rollover force.
- Right lateral center of gravity.
- Crosswinds from the left.
- Left yaw inputs.

For helicopters with clockwise rotor rotation, the opposite would be true.

Precautions

- Guard against ‘catching a skid/wheel’
- ‘Two-Step Lift Off’ allows Cyclic Centering
- Wind from Upslope reduces lateral cyclic margin – unsafe condition
- T/R translation – keep in mind
- Tail Wind & Slope – don’t accept!
- Beware on Floating Platforms

THANK YOU