HUMAN PERFORMANCE & LIMITATIONS

WHY IS IT IMPORTANT?

The aircraft accident that happened over the last 10 years has been classified into six categories according to their main contributing factors. Those results would have been the same if the figures represented the last 30 years or just the last year. The Crew category is the largest one. It represents 70% of the accident. This figure represents all the accidents where the crew could really have done things differently and prevented the accident from happening.

HUMAN FACTORS

MEDICAL INCAPACITATION:

Incapacitation is the loss of strength or the ability to perform normally.

a) Sudden Incapacitation:
The pilot collapses or slumps over the aircraft controls. Heart attack and stroke are common causes.

b) Subtle Incapacitation:
Subtle incapacitation can go unnoticed by the crew-members, which makes this a potentially dangerous situation. The pilot might be dazed, semi-conscious, or unable to move as with a stroke.

c) Total Incapacitation:
Means you are totally out of it, up to and including dead. There is no doubt that there is a problem that needs immediate attention. Common causes are heart attack and food poisoning.

d) Partial Incapacitation:
You are only partly incapacitated; you can still fly but not properly. You may be unaware of your problem.
Common causes:
- Fatigue
- Hypoglycemia (low blood sugar)
- Stress Medication
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- Dehydration
- Jetlag.

INFORMATION PROCESSING ERROR:

What is an error?
A consequence of human involvement which causes deviation from crew or organisational intentions or expectations. Errors may occur either in the presence or absence of threats.

Human Information Processing:

Error Management Process:

Error Prevention:
- Errors are inevitable: we make errors because we make an intelligent use of our limited resources.
- The objective is to detect and correct errors before any negative impact on safety occur.
- Error detection governs our behavior and is a key condition for good performance and flight safety.
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- Error detection is both an individual and a crew responsibility.

**HYPOXIA:**

**What is Hypoxia?**
This is a condition where there is insufficient oxygenation of the blood in the lungs owing to a decreased partial pressure of oxygen in the Alveoli, thus the blood returning to the hear contains less oxygen and therefore the tissues also get less. In aviation this situation develops with a height above 8000 ft, since air density decreases with altitude.

**Causes and Symptoms:**
The first symptoms of hypoxia are usually associated with mental functions owing to the fact that brain tissues are the most sensitive to a lack of oxygen. The rate at which the effects occur, depends upon the altitude. It is possible even at 8,000 ft to observe signs of mental impairment, although generally healthy persons should not be noticeably affected up to 10,000 ft from 10,000 ft upwards, however, the effects become more noticeable and the symptoms, similar to the effects of alcohol, are as follows:

a) **Judgment**
   Reduced performance as a result of the loss of self-criticism

b) **Change in Personality**
   Behavior changes can show as euphoria, aggression or loss of inhibitions.

c) **Muscular Control**
   Reduced decision making results in poor muscular control and uncoordinated movements.

d) **Reduced Memory/Concentration**
   The loss of short term memory can result in difficulty in carrying out normal operating procedures.

e) **Effect on Senses**
   Peripheral vision and night vision are first affected, followed by day vision, color vision, touch and hearing.

f) **Reduced Consciousness**
   If hypoxia continues, the level of consciousness reduces, resulting initially in light headedness, dizziness and confusion, then semi-consciousness, unconsciousness and ultimately death.
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g) Physical
The skin becomes pale and a bluish tint may become noticeable, particularly the finger tips, lips, ears and nose, (this is called Cyanosis), as well as air hunger accompanied by yawning.

Time of useful consciousness following a failure of the Oxygen supply at various altitudes:

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Time of Useful Consciousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL 450</td>
<td>9 - 15 sec.</td>
</tr>
<tr>
<td>FL 400</td>
<td>15 - 20 sec.</td>
</tr>
<tr>
<td>FL 350</td>
<td>0.5 - 1 min.</td>
</tr>
<tr>
<td>FL 300</td>
<td>1 - 2 min.</td>
</tr>
<tr>
<td>FL 280</td>
<td>2.5 - 3 min.</td>
</tr>
<tr>
<td>FL 250</td>
<td>3 - 5 min.</td>
</tr>
<tr>
<td>FL 220</td>
<td>5 - 10 min.</td>
</tr>
<tr>
<td>FL 200</td>
<td>20 - 30 min.</td>
</tr>
</tbody>
</table>

Methods to Combat Hypoxia:

a) Supply Oxygen

b) Emergency descend to below 10,000 feet if terrain clearance is not a factor.

VISUAL FACTORS AFFECTING PILOTS:

1. Visual Perception
   It involves the eyes, brain and balance organs. It is influenced by expectation and emotion.

2. Expectation
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What I think or hope will happen.
Involves the pre-selection of the stored mental model required and fitting or selecting of input to match.

3. Visual Illusion
Occur when the incorrect mental model is matched with the sensory input you do not always perceive with what you see.

a) False Horizon
Common during flight in partial visual condition, the pilot observes sloping cloud formations, and obscured horizon, or at night, a combination of stars and ground lights, and geometric ground light patterns, all of which present an illusion to a disorientated pilot of not being correctly aligned with the true horizon.

b) Ground Lighting
Many pilots, especially in unfamiliar areas, have mistaken lights along a straight road or on a moving train, as approach or runway lights. The judgment of distance may also be affected by bright runway and approach light systems. The illusion is that of less distance to the runway and the natural result is a high approach. Similarly, when flying over a relatively unlit area, the lack of lights reduces height cues and the pilot may fly a low approach. A combination of bright approach lights and a relatively black unlit inbound terrain increases the tendency to fly a low approach, sometimes referred to as the blackhole effect.
c) Environmental Perspective
From birth we develop the mental model that anything that is indistinct is far away and vice versa. This is not always so as atmospheric conditions alter visibility.

Is the green side near of you? Is the green side is inside this box? This box is really not stable.

d) Landing Illusions
Pilots are trained to adapt a mental model of the shape of a flat runway as it appears on a normal 3 degree approach path. However, if we select this model for a sloping runway we have an illusion producing inappropriate actions.

When approaching a sloped runway, the tendency is to position the aeroplane so the runway appears as it would for a normal, flat runway. On a runway that slopes uphill, this produces a dangerously low approach. For a downhill runway, it produces a high approach with the possibility of overshooting the runway. The runways depicted to the left show how normal three-degree approaches might look for upslope and downslope runways.
Runways width produces a stored mental model related to the angle between our eyes and the edges of the runway during the flare. If we use a runway of different width this can induce an illusion again of being too high or too low, when we are in-fact on the correct approach and a consequent “heavy” landing.

**FATIGUE:**

**Signs of Fatigue:**
- a) Judgment errors
- b) Forgetfulness
- c) Sleepiness
- d) Loss of appetite
- e) Aggressiveness
- f) Inaccurate flying
- g) Lower standards

**Jet Lag**
- a) Disrupt body-clock/sleeping pattern.
- b) Ways to combat jet-lag:
  - Proper Diet
  - Rest Period
  - Environment

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New York is 5 hours behind London, so noon occurs 5 hours later; this means that a person arriving from London experiences a 25-hour day. The body clock is 25 hours, so the 25-hour body clock will tend to close the gap naturally in 4 days, and even less with the aid of zeitgebers.

London is 5 hours ahead of New York, so noon occurs 5 hours earlier; thus, a person arriving from New York experiences 19-hour day. The body clock is 25 hours, so:

- 19-hour body clock. 1 ½ hours worse off than the reverse flight.
- Zeitgebers’ work to remove this by reducing the body clock to less than 24 hours (hard work).
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Sleep/wake cycle
a) Follows a 24-hour rhythm with approximately 1/3 of the time being sleep.
b) It is generally difficult to stay awake when the body temperature is low.

Credit-Debit System
a) Sleep deprivation and the likelihood of sleep can be predicted using this concept:
   - +2 pts for every hour of sleep
   - -1 pts for every hour of awake
   - +16 is never exceeded
b) A gradual reduction of sleep may build up over time called ‘Cumulative Sleep Debit’.