HUMAN FACTORS BEYOND THE SLOGAN

4º Simpósio de Segurança de Voo (SSV)
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Katherine Andrea Lemos, Ph.D.
Instituto Técnico de Aeronáuticas
São José dos Campos, Brasil

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OBJECTIVOS

▪ Provide an overview of the multiple aspects of human factors in aviation safety
  ▪ Expand beyond widely publicized, traditional concepts
  ▪ Tangible examples across the broad spectrum lifecycle

▪ Encourage you to consider how human factors affects aviation safety in your world
  ▪ Line operations or management
  ▪ Design, certification & continued operational safety (COS)

▪ Encourage: Question and Test Assumptions

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AGENDA E HORÁRIO

- **Seção 1: 1330 – 1415**
  - O Que É Fatores Humanos: Fatores Tradicionais

- **Seção 2: 1415 – 1500**
  - Dados de Segurança e Exemplo de Acidentes
    - *Intervalo para Café 1500-1530*

- **Seção 3: 1530 – 1615**
  - Responsabilidade Organizacional e Individual

- **Seção 4: 1615 – 1700**
  - Considerações de Projeto e Automação

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**O QUE É FATORES HUMANOS?**

- Hipóxia
- S.O.P.
- CRM
- Desorientação Espacial
- Profissionalismo
- Fadiga
- Cultura de Segurança
**SIM: É HIPÓXIA**

- **Accident:** Payne Stuart
  - October 25, 1999
  - Learjet Model 35
  - Aberdeen, South Dakota
  - Fatalities: 2 pilots; 4 pax

- NTSB Probable Cause: “**Incapacitation** of the flight crewmembers as a result of their **failure to receive supplemental oxygen** following a **loss of cabin pressurization**, for undetermined reasons.”

Human Factors: Beyond the Slogan
Prof. Katherine Andrea Lemos, Ph.D.
SSV 2011
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Human tolerance to Hypoxia is measured as:
- Time from exposure to an oxygen deficient environment to the inability to perform normal tasks or take appropriate action.
**SIM: É HIPÓXIA**

- **Known:** Payne Stewart
  - Air shutoff/regulator valves were closed
  - Flow control valve was closed
  - Loss of bleed supply air to cabin
  - No cabin pressurization aural alert at last transmission
  - CVR 30 min only: Cabin pressurization aural alert
  - Hypoxia occurred within a 6 min 20 sec max window

- **Unknown:**
  - Reason for closed flow control valve
  - Quantity and quality of oxygen
  - **Reason** crew did not receive supplemental oxygen

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**SIM: É HIPÓXIA**

- **Incident:** Kalitta Flight 66
  - June 26, 2008 en route Ypsilanti, MI
  - Above FL260
  - **Incomplete loss of pressurization**
  - Captain hand-flying, declared an emergency
  - Captain insists on original destination
  - **Fellow controller recognizes signs of hypoxia and commands the aircraft to descend**
  - ~FL110 the pilot had recovered, and confirms that he had been suffering from hypoxia
**SIM: É HIPÓXIA**

- **Accident:** Helios 522
  - August 14, 2005
  - B737
  - Grammatikos, Greece
  - 121 Fatalities

- **Cabin Altitude Calculations**
  - 12,500' Actual, Cabin 10,000'
  - 16,650' Actual, Cabin 13,500'
  - 18,200' Actual, Cabin 14,700'

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**Map of Sequence of Events**
"My mind clicks on and off... I try letting one eyelid close at a time when I prop the other open with my will. But the effort’s too much. Sleep is winning. My whole body argues dully that nothing, *nothing life can attain is quite so desirable as sleep.*

My mind is *losing resolution* and *control."

- Charles A. Lindbergh

**Fatigue:** “State of diminished mental or physical efficiency.”
SIM: É FADIGA

- 2 hours sleep loss
  - Productivity decreases by 17 percent

- 4 hours sleep loss
  - Productivity decreases by 43 percent

- Mark Rosekind, Ph.D.

- After being awake for 18 hours, mental and physical performance on many tasks can be like having a blood-alcohol content (BAC) of 0.05.

- After being awake for 23 continuous hours, people perform as badly as people who have a BAC of 0.12.

  - Dawson and Reid, as reported in Reason’s “Managing Maintenance Error.”

The level of error-provoking conditions in maintenance workplaces.

- Source: Alan Hobbs, September 2004
SIM: É FADIGA

**Accident:** American International Airways
- August 18, 1993
- DC-8 freighter
- Stall and loss of control on final approach
- Guantanamo Bay Naval Air Station, Cuba

**NTSB: Fatigue Was a Direct Factor**

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**The following exchange of conversation was recorded by the CVR:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Role</th>
<th>Conversation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1653:28</td>
<td>Captain</td>
<td>where's the strobe</td>
</tr>
<tr>
<td>1653:29</td>
<td>Flight Engineer</td>
<td>right over there</td>
</tr>
<tr>
<td>1653:31</td>
<td>Captain</td>
<td>right inside there, right inside there</td>
</tr>
<tr>
<td>1653:33</td>
<td>First Officer</td>
<td>you know, we're not getting our airspeed back there</td>
</tr>
<tr>
<td>1653:35</td>
<td>Flight Engineer</td>
<td>where's the strobe</td>
</tr>
<tr>
<td>1653:37</td>
<td>Captain</td>
<td>right down there</td>
</tr>
<tr>
<td>1653:37</td>
<td>First Officer</td>
<td>I still don't see it</td>
</tr>
<tr>
<td>1653:41</td>
<td>Captain</td>
<td># we're never goin' to make this</td>
</tr>
<tr>
<td>1653:42</td>
<td>Flight Engineer</td>
<td>where do you see a strobe light</td>
</tr>
<tr>
<td>1653:45</td>
<td>Captain</td>
<td>right over here</td>
</tr>
<tr>
<td>1653:48</td>
<td>First Officer</td>
<td>where's the strobe</td>
</tr>
<tr>
<td>1653:57</td>
<td>Captain</td>
<td>do you think you're gonna make this</td>
</tr>
<tr>
<td>1653:58</td>
<td>First Officer</td>
<td>yeah...if I can catch the strobe light</td>
</tr>
<tr>
<td>1654:01</td>
<td>Captain</td>
<td>five hundred, you're in good shape</td>
</tr>
<tr>
<td>1654:06</td>
<td>Flight Engineer</td>
<td>watch the, keep your airspeed up</td>
</tr>
<tr>
<td>1654:09</td>
<td>Sound similar to stall warning</td>
<td></td>
</tr>
</tbody>
</table>

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In the 48 hours prior to the accident: The Captain had slept 8 hours

Prior to the accident: The Captain had been awake 23.5 hours

**Accident**: FedEx 1478
- July 26, 2002, Tallahassee, FL
- Collision with trees on final approach in B727

**Fatigue contributed to degraded performance for Captain and FO**
- Long duty day (FO and FE)
- Early report time (Captain)
- Lack of adequate sleep (Captain)
- Multiple takeoffs and landings (FO and FE)
- Circadian Disruption (FO)
SIM: É FADIGA

- Accident: Shuttle America
  - Flight 6448
  - February 18, 2007
  - Cleveland, Ohio
  - Runway Overrun in Snow Conditions

- Contributing factors included captain’s fatigue and company attendance policy
  - Captain suffered from insomnia
  - Awake 31 of 32 hours
  - Did not “call in fatigued” due to fear of reprisal

DESORIENTAÇÃO ESPACIAL

- Featureless Terrain
  - Juneau Ice Field: 5th largest ice field in North America
    - 1500 square miles of ice, 100 miles long & 45 miles wide

- Sept 10, 1999
  - 3 helicopters lost - 1 day
  - 1 serious injury
  - 5 minor injuries
  - 10 people stranded on ice field overnight
  - 4 million dollars in hull losses

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Pilot Statements

- Elected to cut across ice field instead of staying on edges
- Light snow shower momentarily reduced his forward visibility. Could still see mountains in front (about three miles)
- Slowed helicopter to 70 knots
- No real sense of danger
- “I was sure that I was still about 500 feet above the ice”

Passenger Statements

- Just enjoying the view
- Noticed that the helicopter was slowing down, and thought they were going to make another landing
- Thought the helicopter was about 300 feet above the ice
- Took photo about 20 seconds before impact
DEORIENTAÇÃO ESPACIAL

- Accident: Gulf Air 072
  - August 23, 2000
  - Night landing in A320 at Bahrain Intl Airport
  - Occurred after 2nd go-around
  - Lost outside visual cues 21 seconds prior to impact
  - Pilot likely not attending to Primary Flight Display (PFD)
  - Pilot pitched aircraft forward with controls

- Attributed to somatogravic illusion
- Fatal: 143

- NAMRL Perceptual Study

DEORIENTAÇÃO ESPACIAL

- NAMRL
DEORIENTAÇÃO ESPACIAL

- **Accident:** Copterline  
  - August 10, 2005  
  - Tallin Bay, Estonia  
  - Sikorsky S-76C+ Helicopter  
  - Cumulus clouds – climbing to avoid

- **Extreme vertical acceleration**  
  - 1.5 seconds from +1G to +2.9G

- **Investigation Determined**  
  - Mechanical issue prompted event

- **Human Factors Focus:** Ability of crew to recover

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**Loss of visibility**  
- Cloud bases between ‘800 and ‘1400  
- Upset put them at 1600’

**Extreme attitude changes**  
- Vertical Acceleration (2.9Gs) although loss of speed  
- 75 degree pitch up  
- 70 degree left bank (90 deg change in heading)

**Pilot control inputs/recovery attempt**  
- Extreme right bank (rotation ~2.5sec/360 degrees)  
- Irregular pitch/roll  
- Pitch/roll stabilizing with continued vertical axis rotation
**DESORIENTAÇÃO ESPACIAL**

- NAMRL Calculations: Unaware of right yaw
  - “The pilot was unaware of the high rotational velocity in part due to the normal physiological decay of yaw perception and did not correct for right yaw.”

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**O QUE É FATORES HUMANOS?**

“The technology concerned to optimize the relationships between people and their activities by the systematic application of the human sciences, integrated within the framework of system engineering.”

O QUE É O ERRO HUMANO?

- “Mistake made by a person.” – Encarta

- “An inappropriate or undesirable human decision or behavior that reduces, or has the potential for reducing effectiveness, safety, or system performance.”

- “An action is taken that was ‘not intended’ by the actor; not desired by a set of rules or an external observer; or that led the task or system outside its acceptable limits.”

FATORES HUMANOS: AVIAÇÃO

Human behavior/performance knowledge and principles

Front Line Operator

Organization & System Safety

Design, Certification & COS