Por Que os Operadores Cometem Errões?

RESPONSABILIDADE
INDIVIDUAL E
ORGANIZACIONAL
O QUE É UM SISTEMA?

An *entity* that exists to carry out some *purpose*. A system is comprised of human, machines, and other entities that *interact* to achieve this purpose that separately could not achieve alone.

SISTEMA AVIAÇÃO: HELMRIECH

Regulatory Environment

Organizational Environment

“Corporate Culture”

Physical Environment

Crew
O MODELO DE JAMES REASON

- **Front-Line Operator**
  - Decisions, actions or inactions made by those in direct control of the system
  - Immediate

- **Managers & Regulatory Authorities**
  - Decisions, actions or inactions made by those removed from daily operations
  - “Sleeper” Condition

ACIDENTES SÃO O RESULTADO DA COMBINAÇÃO DE FALHAS ATIVAS E LATENTES

Active & Latent Failures
Active Failures
Latent Failures
Latent Failures
Latent Failures

Reason Model: “Swiss Cheese”

Accident
Limited Opportunity to Prevent or Mitigate
Addressing latent conditions offers the greatest potential for safety improvements.

CULTURA DE SEGURANÇA

Individual + Organization

Promote Safety

Beliefs

Attitudes

Guidelines

Behaviors
Safety culture starts at the top of the organization and permeates the entire organization.

- Indications of whether an operator has a “Safety Culture”
  - Systematic attention to safety
  - Employee empowerment
  - Systems approach
CULTURA DE SEGURANÇA
SYSTEMATIC ATTENTION TO SAFETY

- What the company systematically:
  - Pays attention to and deals with
  - Notices and comments on
  - Measures
  - Controls
  - Rewards

- Multiple sources of information
- Decisions: Safety > Production

CULTURA DE SEGURANÇA
ALL WORDS AND NO ACTION

- EMS Helicopter Accident
  - Pilot not familiar with FADEC system
  - Loss of control – 1 fatal, 3 serious

- Not first indication to the operator
  - Accident pilot and one other pilot previously experienced events of FADEC control in the accident helicopter
  - Operator still did not provide differences training
CULTURA DE SEGURANÇA
EMPLOYEE EMPOWERMENT

- Are safety guidance and SOPs living documents?
  - Does it take an accident to find out which SOPs are not clear or if there is inconsistent guidance?

- Are employees invited to help management improve procedures?
  - Number of reports, type of reports, company response to reports, feedback to employees

- Reporting of discrete events is only one component
  - Processes, procedures, looking for trends, feedback… (SMS)

CULTURA DE SEGURANÇA
SYSTEMS APPROACH

- How were past incidents and accidents handled?
  - Did they go beyond “who” is to blame, to determine “why”?
  - What were the routine actions of that crew, and of other crews?

“Errors by front line operators are hardly an adequate explanation for why something went wrong.” – Andrew Hopkins

Human Factors: Beyond the Slogan
Prof. Katherine Andrea Lemos, Ph.D.
SSV 2011

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CULTURA DA ORGANIZAÇÃO

- Policies, Procedures & Objectives
- Safety Risk Management
- Safety Assurance
- Safety Culture
- Organizational Culture

(Cultura da Organização)

Culture + Climate = Behavior

(Stricoff, 2005)
CULTURA DA ORGANIZAÇÃO

Organizational Culture

Safety Climate

Safety Performance

Goal: Improvement or Maintenance of Safety Performance

(Lemos, 2010)

Um Exemplo de Acidentes

FATORES DO SISTEMA: INDIVIDUAL E ORGANIZACIONAL
### RESUMO DE ACIDENTE

- **Colgan Air, Inc. Flight 3407**
  - February 12, 2009
  - Clarence Center, NY
  - 2217 EST
  - DHC-8-400

- **Approach Phase of Flight**
  - Event: “Loss of Control”
  - 50 Fatalities

- **Approximately 3 miles from “outer marker”**
  - 180kts – too fast for approach
  - 5 degrees of flaps

- **Configuration Changes**
  - Power was reduced to slow the aircraft
  - Gear extended
  - Props to max RPM
  - Flaps set to 15 degrees

- **21 seconds later…**
RESUMO DE ACIDENTE

- **Stick Shaker (stall warning)**
  - Activated at 131kts
  - Autopilot disconnect (automatic)
  - Flaps were at about 10 degrees (not fully deployed)

- **Captain’s Reaction**
  - NTSB: “startle and confusion”
  - Pulled nose to 19 degrees pitch UP
  - Increased power ~75%
  - Stall – extreme roll
  - Stick shaker activated 3 times, followed by stick pusher
    - Countered by Captain’s action of pulling – 35lbs force
  - Loss of Control

FATORES QUE NÃO CONTRIBUÍRAM

- **Flight crew properly certificated**
- **Aircraft properly certificated and in good / working condition**
  - No evidence of pre-impact structural, engine or aircraft systems failures

- **Ice accumulation not a factor**
  - Some ice on the aircraft
  - Minimal aircraft performance degradation from ice
    - Degradation factor, on a scale of 0 – 10 was about 1-2
  - Ice did not affect the crew’s ability to control the aircraft
**Fatores Identificados de Sistemas**

- SOPs, Monitoring & Leadership
- Pilot Selection
- Stall Training and Awareness
- Fatigue

**Falhas Ativas**

- **Lack of adherence to SOP**
  - Violation of “Sterile Cockpit”
    - Crew conversed continuously
  - Untimely performance of duties
    - Approach briefing
    - Descent and approach checklists
  - Stall recovery actions – not SOP

- **Failure to Monitor**
  - No monitoring of airspeed for at least 21 seconds prior to stick shaker

- **Leadership / CRM**
  - Lack of communication – addresses captain’s leadership role
    - Increased Vref switch set by FO not verified with/by Captain
    - No communication during event between crew
Fatores Identificados de Sistemas

- SOPs, Monitoring & Leadership
- Pilot Selection
- Stall Training and Awareness
- Fatigue

Dificuldades de Treinamento

- Captain’s actions did not indicate well-learned habit pattern
  - Improper inputs consistent with “startle and confusion”
  - History of training failures may have played a role

- Points to Organizational Factors (per the NTSB):
  - “The captain had not established a good foundation of attitude instrument flying skills early in his career, and his continued weaknesses in basic aircraft control and instrument flying were not identified and adequately addressed.”
  - “Colgan Air did not use all available sources of information on the flight crew’s qualifications and previous performance to determine the crew’s suitability for work at the company.”
### CAPTAIN’S RECORD OF FAILED FAA CHECKRIDES

<table>
<thead>
<tr>
<th>Date of Checkride</th>
<th>Certificate Attempted</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 1991</td>
<td>Instrument Rating</td>
</tr>
<tr>
<td>May 2002</td>
<td>Commercial SEL</td>
</tr>
<tr>
<td>March 2004</td>
<td>Commercial MEL</td>
</tr>
<tr>
<td>October 2007</td>
<td>ATP and Saab 340 type rating</td>
</tr>
</tbody>
</table>

### ADDITIONAL TRAINING DIFFICULTIES

<table>
<thead>
<tr>
<th>Date</th>
<th>Difficulty Encountered</th>
<th>Checking Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2005</td>
<td>graded “train to proficiency”</td>
<td>initial Saab 340 flight check</td>
</tr>
<tr>
<td>October 2006</td>
<td>unsatisfactory</td>
<td>recurrent Saab 340 flight check</td>
</tr>
<tr>
<td>October 2007</td>
<td>unsatisfactory</td>
<td>Saab 340 upgrade proficiency check</td>
</tr>
</tbody>
</table>
DIFICULDADES DE TREINAMENTO

- Successful transition to Q400 in December 2008
  - 2 months active duty on Q400 at time of accident

- Noted history of “over-controlling” during check rides
  - Simulator Instructor: “Captain was rough on flight controls and over-controlled roll axis
  - Consistent with previous aircraft control problems noted in check rides prior to employment with Colgan

- NTSB: Training Recommendations:
  - Remedial Training
  - Inadequate details maintained in records – unable to track
  - Regulations do not require verification of historical records

FATORES IDENTIFICADOS DE SISTEMAS

- SOPs, Monitoring & Leadership
- Pilot Selection
- Stall Training and Awareness
- Fatigue

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TREINAMENTO E PROJETO: STALL

- Stall training not conducted past stick shaker
  - Emphasis on prevention of stall event
    - Relies on avid pilot monitoring
- Simulator fidelity not adequate
  - Potential negative transfer of training
    - Simulator algorithms not adequate to represent accurately
    - Some crews associate buffeting with turbulence
- Stall training does not include realistic scenarios
  - Realistic: Autopilot engaged
  - Less Realistic: Current regulations for Departure/Approach Manual Stall
- Design of avionics to alert of pending stall
  - No aural alert to draw attention
  - No connection between increased stall speed (ice) to Vref set on PFD

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### Human Factors: Beyond the Slogan

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### FATORES IDENTIFICADOS DE SISTEMAS

- SOPs, Monitoring & Leadership
- Pilot Selection
- Stall Training and Awareness
- Fatigue

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### FATIGA: OS FATOS

- **Captain**
  - Reduced Sleep Opportunities
    - Stayed overnight in crew room
    - Accessed company computer at 0310 eve prior
    - Accident occurred at normal bedtime (2217)

- **First Officer**
  - Overnight transcontinental commute
    - Seattle (home) to New York (base)
    - Slept on commute and in crew room

- **Fatigue: Not a result of flight and duty time**
FADIGA: A RESPONSABILIDADE

**NTSB Conclusions:**

- Fatigue MAY have played a role
- All pilots have personal responsibility to manage their off-duty time
- Colgan Air did not proactively address issue of fatigue
- Operators have responsibility to mitigate risks associated with commuting
The Four P’s
Philosophy, Policies, Procedures & Practices

(Reason and Hobbs)

First, The Three P’s

1. Philosophy
2. Policies
3. Procedure
REGULAÇÃO E PROCEDIMENTOS

Philosophy

Management determines an over-arching view of how they will conduct business of the airline or company

Example: Automation is just another tool to help the pilot.

Example: The maintenance crew will maintain aircraft in a top mechanical fashion, keeping safety a top priority.

Policy

Broad specifications to describe the manner that management expects things to be done

Example: Use or non-use of automation feature is left to the discretion of the crew.

Example: Maintenance will be conducted in accordance with approved Maintenance Manual.
Procedures should be consistent with policies

**Example:** On a Cat I ILS approach, the flight crew will determine the level of automation to be used. This may be fully coupled to the autopilot, or it may be hand flown.

**Example:** All RII functions will be performed by qualified inspectors, who have not been involved with or participating in the actual work of the item(s) to be inspected.

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**REGULAÇÃO E PROCEDIMENTOS**

**The Fourth P: Practices**

- Procedure
- Crew
- Conform
- Deviate
- Practices
The Fourth P: Practices

- **Procedure**
- **Crew**
- **Conform**
- **Deviate**
- **Practices**

How SOPs relate to error

- **University of Texas LOSA data show that:**
  - Crews who intentionally erred by not following SOPs were 3 times more likely to commit another error with consequential results.

- **Maintenance Errors**
  - Often occur in a linked sequence, with one error leading on to the next. Making an error can greatly increase the chances of making a subsequent error.  
  
  *(Reason and Hobbs)*
**REGULAÇÃO E PROCEDIMENTOS**

**3 Potential Gaps**

1. The organization does not have *adequate* written policies, procedures and guidelines.

2. They don’t *rigorously adhere* to what they do have (and lack of enforcement).

3. Policies, procedures or guidelines send a *conflicting message* of priorities, or are not in *alignment* with management philosophy.

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**October 25, 2002**

Inadequate Written Policies, Procedures and Guidelines
Standardization

- **Maneuvers Guide**: Contained key procedures for briefing and conducting instrument approaches
  - Pilots were expected to adhere to procedures in the Maneuvers Guide
  - Maneuvers Guide was only issued to the Chief Pilot and Instructors

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**Lead Ground Instructor:**
- Suspected some pilots were following SOPs while others were not
- Aware that some pilots used their own checklists instead of company checklists

**Company Pilot:**
- Never saw any standardized call-outs documented in company manuals. To compensate, she used callouts she used at another company.

**Employees Rated Company Standardization:**
- Company Check Airman: "6" (out of 10)
- Company Pilot: "Fair to Good"
- Lead Ground Instructor: "Fair"
“When asked about the flight department’s standard operating procedures (SOPs), the chief pilot advised that they did not have any…”

“…the flight department had started out as just one pilot and one airplane, and that they now had five pilots and two airplanes…”
Lack of Adherence

**Hudson River Midair Collision**
- August 8, 2009, 1153 EDT
  - Visual Conditions (VMC)
  - Piper PA-32R-300
  - Part 91 Operation
  - Eurocopter AS350BA
    - Liberty Helicopters
    - Parts 135 and 136 Operation
  - 9 Fatalities

(NTSB, 2010)

**NTSB Issues Identified:**
- Local Controller initiated two personal phone calls while providing ATC services.
- **Front line manager** was in the tower for the first call but **did not address** the issue as required.
- After accident, local controller **could not locate** front line manager and other controller-in-charge.
- ATC recordings before accident revealed:
  - **Multiple instances of non-compliance** with FAA and Teterboro ATC orders by **local controller**, and
  - **Lack of oversight** by **front line manager**