Human Error in the Context of Accidents

Society of Experimental Test Pilots
April 28, 2009

Robert Sumwalt, Board Member
NTSB

“How could they miss it?”
Error – the failure of planned actions to achieve their desired results.

- “Managing Maintenance Error.” James Reason and Alan Hobbs

• An error is a human action (or human behavior) that unintentionally deviates from the expected action (or behavior).

  – From Boeing Maintenance Error Decision Aid (MEDA) User’s Guide
Why investigate accidents and incidents?

“The sole purpose of the investigation of an accident or incident shall be the prevention of accidents and incidents.”

- ICAO Annex 13 Paragraph 3.1

“The discovery of human error should be considered the starting point of the investigation, and not the ending point.”
Active Failures

• Most associated with “front line operators” i.e., pilots, controllers, mechanics
• Consequences known soon after mistake is committed
  – Pilot forgets to lower landing gear
  – Mechanic fails to replace O-rings

Latent Conditions

• Often the result of decisions or actions by management
  – often with good intentions
• Consequences of this decision / action may be not manifested for a period of time
  – decision to merge two airlines without providing training to standardize operating procedures
Addressing latent conditions offers the greatest potential for safety improvements.

System Failures That Contribute to Accidents

Types of Failure

Information about events

ACTIVE

LATENT

Two Icing Accidents

- Allegheny Airlines          February 1979
  (changed name to USAir in 1979)
- USAir                              March 1992
Allegheny 1979

“The NTSB determines that the probable cause of the accident was the captain’s decision to take off with snow on the aircraft’s wing and empennage surfaces…”

<table>
<thead>
<tr>
<th>Date</th>
<th>Airline</th>
<th>Aircraft Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1979</td>
<td>Allegheny Airlines</td>
<td>Nord 262</td>
<td>Clarksburg, WV</td>
</tr>
<tr>
<td>February 1980</td>
<td>Redcoat Air Cargo</td>
<td>Britannia 253F</td>
<td>Boston, MA</td>
</tr>
<tr>
<td>January 1982</td>
<td>Air Florida</td>
<td>B737</td>
<td>Washington, DC</td>
</tr>
<tr>
<td>February 1985</td>
<td>Airborne Express</td>
<td>DC-9-10</td>
<td>Philadelphia, PA</td>
</tr>
<tr>
<td>December 1985</td>
<td>Arrow Air</td>
<td>DC-8</td>
<td>Gander, Newfoundland</td>
</tr>
<tr>
<td>November 1987</td>
<td>Continental Airlines</td>
<td>DC-9-10</td>
<td>Denver, CO</td>
</tr>
</tbody>
</table>
### Icing Accidents
(continued)

<table>
<thead>
<tr>
<th>Date</th>
<th>Airline</th>
<th>Aircraft</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1989</td>
<td>Air Ontario</td>
<td>F28</td>
<td>Dryden, Ontario</td>
</tr>
<tr>
<td>November 1989</td>
<td>Korean Air</td>
<td>F28</td>
<td>Kimpo, Korea</td>
</tr>
<tr>
<td>February 1991</td>
<td>Ryan International</td>
<td>DC-9-15</td>
<td>Cleveland, OH</td>
</tr>
<tr>
<td>December 1991</td>
<td>SAS</td>
<td>MD80</td>
<td>Stockholm, Sweden</td>
</tr>
<tr>
<td>March 1992</td>
<td>USAir</td>
<td>F28</td>
<td>New York, New York</td>
</tr>
</tbody>
</table>
USAir 405 - 1992

“The NTSB determines that the probable causes of this accident were the failure of the airline industry and the Federal Aviation Administration to provide flightcrews with procedures, requirements, and criteria compatible with departure delays in known icing conditions, and the decision of the flightcrew to take off …”
July 10, 2007, Sanford, FL

- Cessna 310 owned by NASCAR
- Flight planned Daytona Beach to Lakeland
- Inflight emergency, request for immediate diversion, crash
- 5 fatalities
Pilots

• Left seat, PIC
  – NASCAR medical officer
  – Commercial Pilot Certificate
  – 276 total flight hours

• Right seat
  – Full time NASCAR pilot
  – ATP
  – 10,580 total flight hours

Declared Emergency

“Smoke in the cockpit.”

“Shutting off radios, elec.”
Events - Previous Day

- That pilot followed company procedures
  - White original in airplane binder
  - Verbally informed technician
  - Handed yellow copy to DOM
- Brief in-office discussion
- Airplane not inspected, modified, or grounded
- Airplane remained available for flight
Active Failures

MECHANIC
• Did not inspect maintenance log or correct the discrepancy

PILOTS
• ATP dismissed radar issue as unimportant
• Weather radar circuit breaker likely reset for the flight
• Pilots accepted airplane “as is” and departed

Inadequate Organizational Processes and Procedures

• Maintenance forms not serialized, tracked, or retained
  – Yellow copy never provided
• SOP guidance versus reality
• No assurance discrepancies would be addressed
• Airworthiness status unclear
• No procedures for providing flight operations personnel (pilots and dispatchers) with airplane airworthiness information.
**Inadequate Procedures**

- Most often a preflight fact sheet would be taped to airplane with highlighted items signed off by a mechanic
  - Not a requirement, not spelled out in SOP
- No guidance was provided to PIC for determining airworthiness of assigned aircraft

---

**Culture of Non-Compliance**

- Aviation director could not readily locate SOP manual
- SOP manual viewed as a “training tool”
- Aircraft to only be used for company business
  - Accident flight was a personal flight
- PIC must possess ATP
  - PIC did not possess ATP
- Last 3 maintenance discrepancies had not been addressed
**Latent Conditions**

- NASCAR enabled the accident by failing:
  - to have adequate processes and procedures to prevent such an event, and
  - to ensure compliance with the procedures they did have in place.

- “This accident started before the aircraft even left the ground.”

**Probable Cause**

- Actions and decisions by NASCAR’s corporate aviation division’s management and maintenance personnel to allow the accident airplane to be released for flight with a known and unresolved discrepancy, and;

- The accident pilots’ decision to operate the airplane with that known discrepancy, a discrepancy that likely resulted in an in-flight fire.
Air Inter A320 Accident

• Strasbourg, France
• January 20, 1992
• 87 fatalities
• Instrument approach
• Night
• Snowing, overcast, low visibility
• Capt 162 hrs in A320
  F/O 61 hrs in A320
• Crew coordination /communications

3.3 degree flight path to Rwy 5
Elevations and altitudes shown as above runway elevation
This window displays either V/S or FPA, as selected by “HDG/TRK button.

Selected V/S is 3300 FPM

Selected FPA is 3.3 degrees
Manufacturer Modifications

Examples:

3300 for vertical speed

3.3 for flight path angle
• Gulfstream G-3, N85V
• On approach to Houston Hobby
• November 22, 2004
• 3 Fatalities
G-3 at Houston

Note: The diagram shows the glideslope and the fast/slow indicators on the right and left side of the EADI, respectively, which is opposite of the accident airplane’s configuration.

- Aircraft had GS indicator on Left side of PFD.
  - Fast/Slow on Right side
- Configuration of other company aircraft flown by accident pilots:
  - 5 had GS on Left
  - 3 had GS on Right
- AC 25-11 (July 16, 1987) recommends that GS indication be located on Right side of display,
  - Accident aircraft was manufactured before this guidance was issued.
NTSB Analysis

“The pilots most likely mistook the fast/slow indicator for the glideslope indicator throughout the approach sequence.”

Safety Order of Precedence

1. Design for Minimum Risk (engineering solution)
   - Hazard is corrected and eliminated
2. Control/Guard Solution
   - Guards put up to decrease exposure
3. Personnel Warning System
   - Warn personnel if you can’t eliminate or control the hazard
4. Develop Procedures and Training
