Standard Operating Procedures:

The backbone of professional flight operations

Robert L. Sumwalt
USAir 1016
July 2, 1994
Charlotte, North Carolina
37 fatalities
Failure to follow procedures led to crash, board finds

By CHARLES POPE
Washington Bureau

WASHINGTON — USAir Flight 1016 crashed last year after its pilots blundered into a severe thunderstorm shrouding the Charlotte airport and then responded incorrectly when the threat was recognized, federal safety officials concluded Tuesday.

The picture painted by the National Transportation Safety Board of the events leading to the March 13, 1996, crash is one of miscommunication and misjudgment that could have been avoided, officials said.

In a report presented Tuesday to board members, investigators said the pilots, unaware they were flying through a thunderstorm, were caught off guard when turbulence caused the aircraft to lose altitude, the key indication of thunderstorms.

The board cited the need for better training in recognizing signs of thunderstorms and for improved communication between the pilots and controllers.

“Pilots need to know that turbulence and thunderstorms are not separate phenomena,” said board Chairman James F. Burns. “They are one and the same. This is a reminder that turbulence is a direct indication of a developing thunderstorm.”

The board's report on the crash, which killed 10 and sent more than 300 others to hospitals, is the first of what are expected to be several published this year.

The crew of the USAir jet took off from Charlotte Douglas International Airport on a flight to Chicago but sensed difficulties almost immediately. Turbulence, they told controllers, caused the aircraft to lose altitude.

The pilots, however, were unaware that they were flying into a thunderstorm, said the report. They were not aware of the severe weather because the radar, which should have detected the storm, was not working.

The board cited a lack of coordination between the pilots and controllers for the crash.

The controllers, for example, said they had not been told that the pilots were in a thunderstorm, and they did not consider the turbulence a sign of a storm, the report said.

The board urged the Federal Aviation Administration to review its procedures for communicating with pilots and to consider requiring new radar equipment that could display weather information to pilots.

The board also recommended that airlines institute new procedures for handling turbulence and thunderstorms.

The investigation, which began shortly after the crash, has cost $1 million. The board, which is independent of the FAA, has asked for $1 million a year to carry out its activities.
“Well-designed cockpit procedures are an effective countermeasure against operational errors, and disciplined compliance with SOPs, including strict cockpit discipline, provides the basis for effective crew coordination and performance.”
What accident data show

NTSB safety study of 37 crew-caused air carrier accidents, 1978-1990

- Procedural errors, such as not making required callouts or failing to use appropriate checklists, were found in 29 of the 37 (78%) reviewed accidents
NTSB identified at least 86 accidents involving:
- lack of adequate procedures, policies, or checklists, or
- lack of flight crew adherence to procedures, policies, or checklists

These accidents resulted in 149 fatalities.
### Accident Prevention Strategies

#### Hull-loss Accidents over 10 Year Period

<table>
<thead>
<tr>
<th>Primary Factor</th>
<th>Percentage of Accidents</th>
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<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
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</table>
| Pilot Flying (PF) adherence to procedure | ![Bar Chart](image)
| Other operational procedural considerations | ![Bar Chart](image)
| Pilot Not Flying (PNF/PM) adherence to procedure | ![Bar Chart](image)
| Embedded piloting skills | ![Bar Chart](image)
| Design improvement | ![Bar Chart](image)
| Captain or instructor pilot exercise of authority | ![Bar Chart](image)
| Maintenance or inspection action | ![Bar Chart](image)
| Approach path stability | ![Bar Chart](image)
| ATC system performance | ![Bar Chart](image)
| First officer’s cross-check performance as non-flying pilot | ![Bar Chart](image)
| Go-around decision | ![Bar Chart](image)
| Runway hazards | ![Bar Chart](image)

Source: Boeing study of accident prevention strategies

**138 Accidents 5,686 Fatalities**

Each bar represents the percentage of hull-loss accidents that contained at least one instance of the listed prevention strategy.
Why SOPs are not followed

- Organization lacks adequate SOPs
- Organizations don’t adhere to their SOPs
- Flight crews intentionally disregard SOPs
Why SOPs are not followed

ORGANIZATION LACKS ADEQUATE SOPS
“When asked about the flight department's standard operating procedures (SOPs), the chief pilot advised that they did not have any…”

Atlanta, Georgia
September 14, 2007

“…the flight department had started out as just one pilot and one airplane, and that they now had five pilots and two airplanes…”
“SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crewmembers.”
NTSB finding: East Coast Jets

• “Although as a [charter] operator East Coast Jets is not required to incorporate SOPs in its operations manual, if the company had voluntarily incorporated SOPs into its guidance, it may have supported the accident pilots in establishing cockpit discipline and, therefore, a safer cockpit environment.”
APPROACH PROFILE: LNAV, LOC, or LOC B/CRS

Complete Approach Briefing
Complete Preliminary Landing Checklist

When cleared for the approach:
• Select LNAV, LOC, or LOC B/CRS
  as appropriate
• Verify armed
• Set raw data backup, as required

2-1/2 miles from FAF:
• Clear down
• Flaps 20
• Set V_{REF} +20
• Initiate Landing Checklist

At 1,000 ft AGL:
• Stabilized Approach
  At MDA or MDA Buffer Altitude:
  • Set missed approach altitude
  • If runway environment is in sight and the aircraft is in a position from which a normal approach to the intended runway can be made, land the aircraft.
  - or -
  • If runway environment is not in sight, perform a missed approach procedure.

Aircraft not equipped with B/CRS feature, use LNAV
### LNAV, LOC, or LOC B/CRS APPROACH -- ACTIONS and CALLOUTS

<table>
<thead>
<tr>
<th>Callouts: in “BOLD TEXT” -- Actions: with bullets (*) in plain text</th>
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<tbody>
<tr>
<td><strong>Initial Approach</strong></td>
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<td>2-1/2 miles from FAF</td>
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<td>1/2 mile prior to FAF</td>
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- **Designates which crewmember performs action or callout**
- **Triggering event**
- **Callout**
- **Action**
Why SOPs are not followed

ORGANIZATIONS DON’T ADHERE TO THEIR SOPS
Declared Emergency

“Smoke in the cockpit.”

“Shutting off radios, elec.”
**Maintenance Discrepancy Entry**

<table>
<thead>
<tr>
<th>AIRCRAFT:</th>
<th>DATE:</th>
<th>Location:</th>
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<tbody>
<tr>
<td>N561N</td>
<td>07-09-07</td>
<td>D3A</td>
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**MAINTENANCE WRITE-UP**

Entered By: ACT

- RADAR WENT BLANK DURING CRUISE FLIGHT. RECYCLED — NO RESPONSE... SMELL OF ELECTRICAL COMPONENTS BURNING
- TURNED OFF UNIT — PULLED RD
- RADAR CB — SMELL WENT AWAY. — RADAR INOP

**MAINTENANCE CLEARING ACTION**

- Repaired
- Released - Could Not Duplicate
- Loaner Installed

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"**SMELL OF ELECTRICAL COMPONENTS BURNING**"
Organizations don’t follow their SOPs

- 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
Stated the NTSB:

• “This is contrary to industry guidance for SOPs indicating that procedures should be written the way the organization intends to operate, and once the procedures are in place, the organization makes every effort to operate that way.”
Stated the NTSB:

- “[The organization] enabled the accident by failing to have adequate procedures in force to prevent such an event and/or by failing to ensure compliance with the procedures they did have in place.”
Lautman-Gallimore Study

- Found that having a strong commitment to standardization and discipline were among the “key elements of safe operations” observed in a Boeing study.

- “Cockpit procedural language is tightly controlled to maintain consistency and to avoid confusion from non-standard callouts …. Callouts and responses are done verbatim”
Why SOPs are not followed

FLIGHT CREWS INTENTIONALLY DISREGARD SOPS
US Airways Express
January 19, 2010
Charleston, WV

Approximate location of stopped aircraft
Probable cause:

• “…the flight crewmembers’ unprofessional behavior, including their non-adherence to sterile cockpit procedures by engaging in non-pertinent conversation, which distracted them from their primary flight-related duties and led to their failure to correctly set and verify the flaps.”
Intentional non-compliance affects safety

- Intentional crew non-compliance was a factor in 40% of the worldwide accidents reviewed.
  - R. Khatwa & R. Helmreich
Intentional non-compliance leads to other problems

- LOSA data revealed that, compared to crews who followed SOPs, crewmembers who intentionally deviated from procedures:
  - averaged making 3 times more errors
  - mismanaged more errors
  - found themselves in more undesired aircraft situations.
Recommendations for Obtaining Better Compliance
Begin by

• Realizing that well-designed SOPs are essential for safety

• Making a strong commitment for procedural compliance to be a core value of the organization
  – simply having the procedures is not enough
  – religiously following them – and insisting they be followed – must be a way of doing business.
Then

• Go through all manuals, checklists, and procedures.
• Change those that don’t work, are not clear, are outdated, and/or are not followed.
If people aren’t following it...

CHECKLIST
Shoulder Harnesses ..........SECURED
Take Off Briefing..........COMPLETE
Transponder ..........

CHECKLIST
Shoulder Harnesses ..........FASTENED
Take Off Briefing..........COMPLETE
Transponder ..........ON

CHECKLIST
Shoulder Harnesses ..........ON
Take Off Briefing..........COMPLETE
Transponder ..........ON

change it.
Establishing a culture of procedural compliance

- Procedures must not be developed in a vacuum - they must have the input of those who are expected to use them.
- Also, it is critical that crewmembers understand the reason for the procedures.
- Avoid seals, sea otters, and walruses.
- Avoid “Normalization of deviance”
- Avoid selective compliance
Avoid seals, sea otters, and walruses
Avoid seals, sea otters, and walruses

Deepwater Horizon
Avoid seals, sea otters, and walruses

BP Spill Response Plan for that Specific Location:

• Listed a wildlife specialist at University of Miami
  – He left University of Miami 20 years earlier
  – Died 4 years before the plan was even *published*

• Listed incorrect and names and phone numbers for marine life specialists in Texas

• Listed instructions for how to deal with seals, sea otters, and walruses
  – *None of these mammals even live in the Gulf of Mexico*
Avoid seals, sea otters, and walruses

In other words...

Make sure your procedures reflect the way you intend to operate, and then operate that way.
Avoid “Normalization of Deviance”

Normalization of Deviance: When not following procedures and taking “short cuts” and becomes an accepted practice.
Avoid Selective Compliance

• “That is a stupid rule.”
• “I don’t have to comply with that one.”
Check for compliance

• Audit flight crews for compliance

“What gets measured gets done. What gets measured and fed back gets done well. What gets rewarded gets repeated.”

- John E. Jones

• The goal is precision – not perfection.