



NTSB National Transportation Safety Board

Obtaining Better Compliance with Standard Operating Procedures (SOPs):

As essential component in improving aviation safety

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 Na

APRIL 5, 1995

NO. 95
104TH YEAR
4 SECTIONS
46 PAGES
© 1995 THE STATE

Pilo



cited

in dangerous weather
near situation
measures to escape the wind shear
and complete weather

children
advisories

*Failure to follow
procedures led
crash, board*

From an NTSB accident report

- “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



What accident data show

Turbine-powered operations (2001 – 2010):

- NTSB identified at least 86 accidents involving:
 - lack of sufficient procedures, policies, or checklists availability, or
 - lack of flight crew adherence to procedures, policies, or checklists

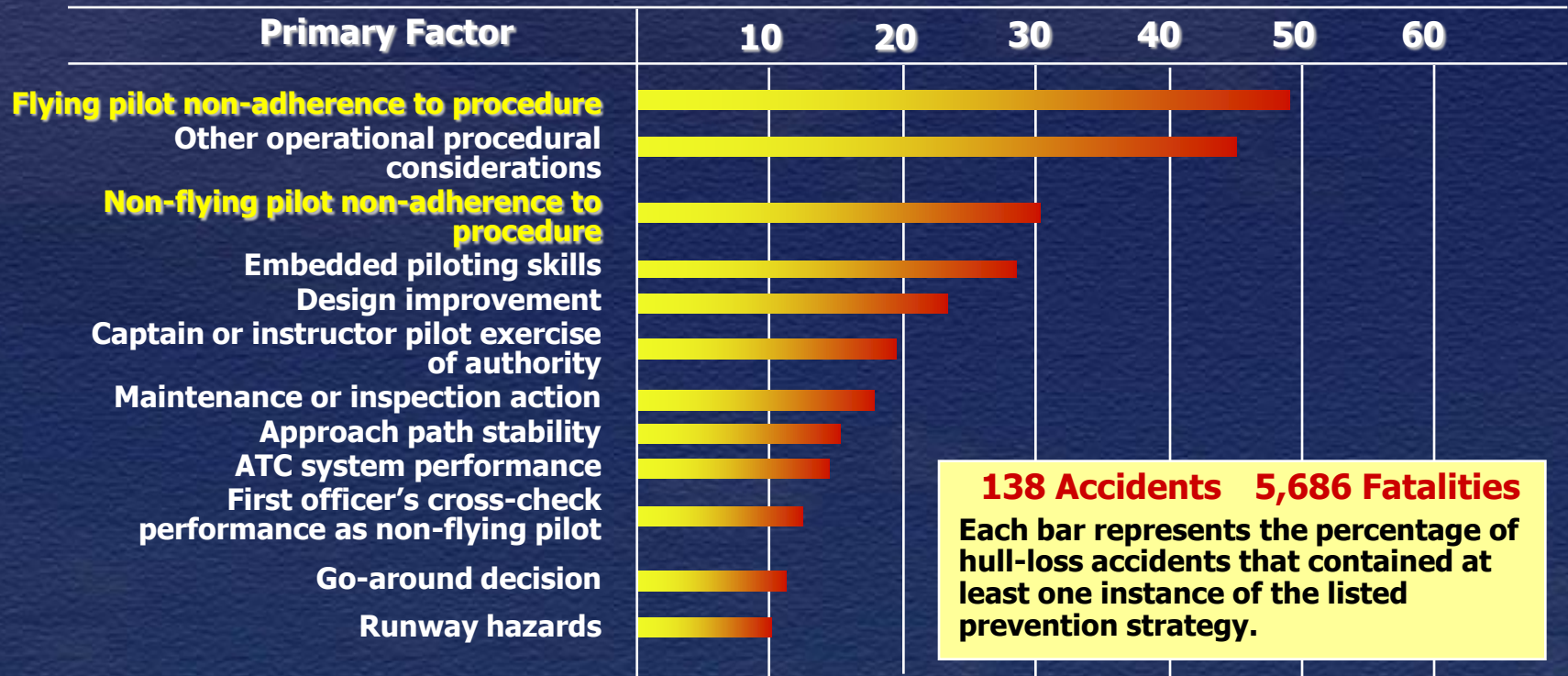
These accidents resulted in 149 fatalities.

What accident data show

Accident Causal Factors

Hull-loss Accidents over 10 Year Period

Percentage of Accidents

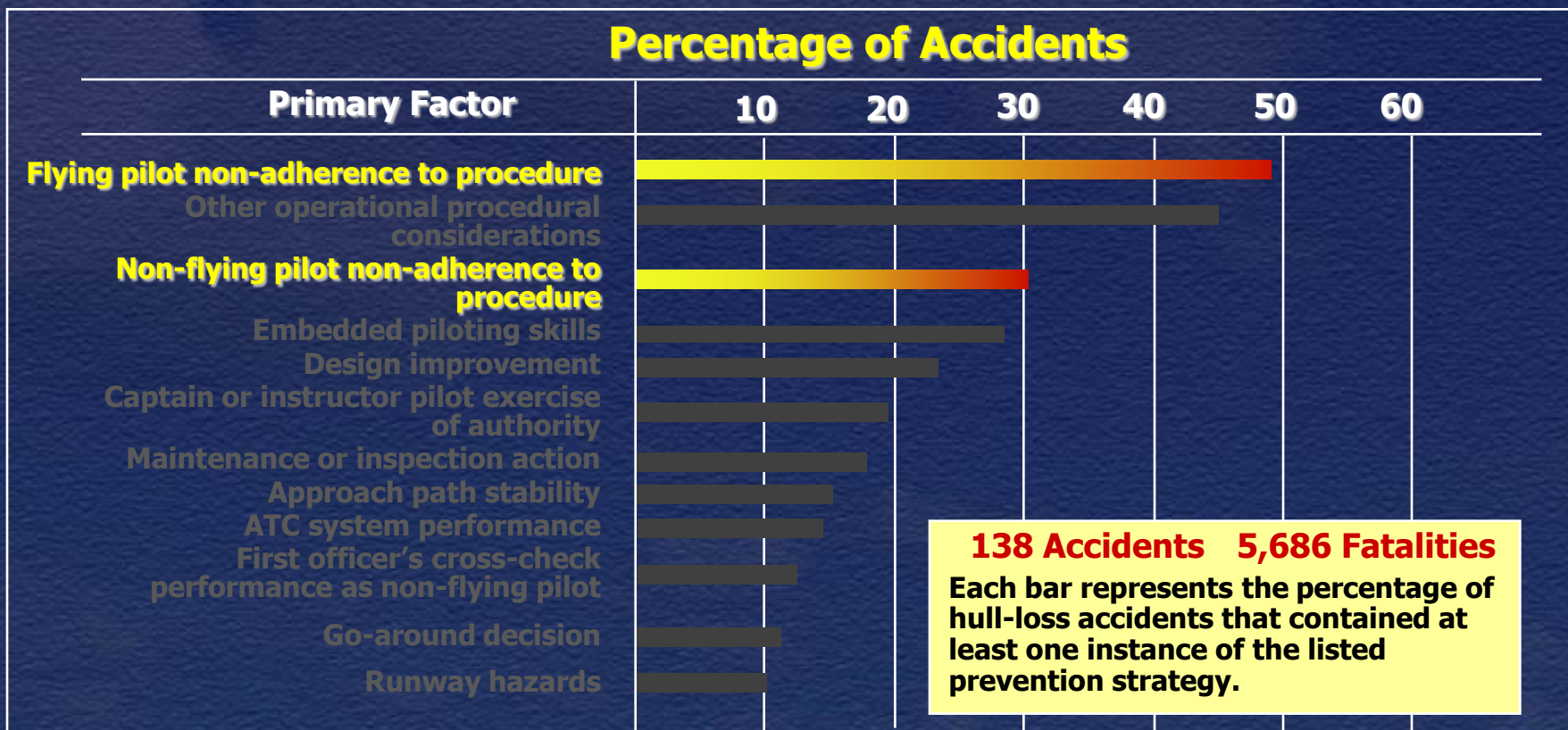


Source: Boeing study of accident prevention strategies

What accident data show

Accident Causal Factors

Hull-loss Accidents over 10 Year Period



Source: Boeing study of accident prevention strategies



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

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“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...”

09 14 2007

FAA Advisory Circular AC 120-71A

Advisory Circular



Date: 2/27/03
Initiated By: AFS-210

AC No: 120-71A

Subject: STANDARD OPERATING PROCEDURES FOR FLIGHT DECK CREWMEMBERS

I. PURPOSE.

a. **General.** Standard operating procedures (SOPs) are universally recognized as basic to safe aviation operations. Effective crew coordination and crew performance, two central concepts of crew resource management (CRM), depend upon the crew's having a shared mental model of each task. That mental model, in turn, is founded on SOPs. This advisory circular (AC) presents background, basic concepts, and philosophy in respect to SOPs. It emphasizes that SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crewmembers.

b. **Using this Advisory Circular.** This AC is designed to provide advice and recommendations about the development, implementation, and updating of SOPs. Appendix 1, Standard Operating Procedures Template, provides many important topics that should be addressed in SOPs. Stabilized Approach, characterized by a constant-angle, constant-rate of descent ending near the touchdown point where the landing maneuver begins, is among the SOPs specifically identified in this AC and is described in Appendix 2, Stabilized Approach: Concepts and Terms. These and the other appendices represent a baseline and a starting point. Start-up certificate holders and existing certificate holders should refer to the Template in Appendix 1, to Stabilized Approach in Appendix 2, and to the other appendices in developing comprehensive SOPs for use in training programs and in manuals used by their flight deck crewmembers.

c. **What's New in this Advisory Circular.** AC 120-71A revises and supersedes the earlier version, AC 120-71. Many minor changes have been made to improve clarity, accuracy, completeness, and consistency. Two significant changes are the conversion of the term pilot not flying (PNF) to pilot monitoring (PM) and the addition of a related Appendix addressing "Crew Monitoring and Cross-Checking." It is increasingly acknowledged that it makes better sense to characterize pilots by what they are doing rather than by what they are not doing. Hence, pilot flying (PF) remains an appropriate term and is unchanged in this AC. But the term pilot not flying misses the point. Studies of crew performance, accident data, and pilots' own experiences all point to the vital role of the non-flying pilot as a monitor. Hence, the term PM is used liberally throughout this AC. In those instances where the older term PNF appears, it should be understood that pilot monitoring (PM) is the preferred meaning.

“SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crewmembers.”

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**East Coats Jets
Hawker Beechcraft BAe 800
July 31, 2008
8 fatalities**



NTSB finding: East Coast Jets

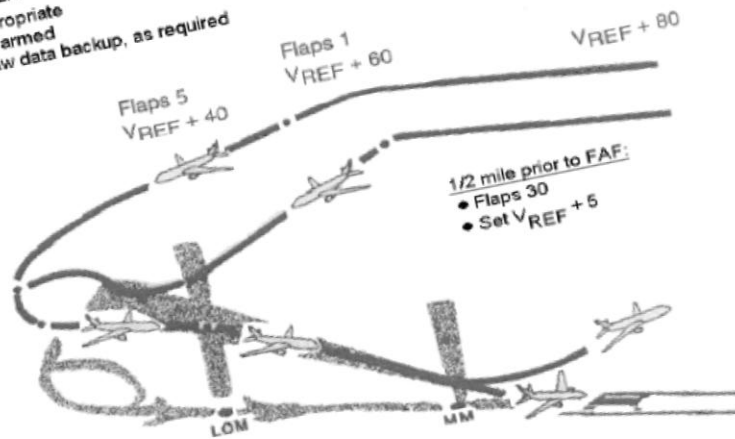
- “Although as a [charter] operator East Coast Jets is not required to incorporate SOPs in its operations manual, if the company had voluntarily incorporated SOPs into its guidance, it may have supported the accident pilots in establishing cockpit discipline and, therefore, a safer cockpit environment.”

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:

- Gear down
- Flaps 20
- Set VREF + 20
- Initiate Landing Checklist

At 1,000' HAT:

- 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

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LNAV, LOC, or LOC B/CRS APPROACH – ACTIONS and CALLOUTS

Callouts: in "BOLD TEXT" – Actions: with bullets (•) in plain text		PM
Initial Approach	<p>PF</p> <p>"FLAPS 1 REF 60"</p> <p>"FLAPS 5, REF 40"</p>	<ul style="list-style-type: none"> • Select flaps 1 • Set command airspeed cursor to V_{REF} 30 + 60, if requested • Select flaps 5 • Set command airspeed cursor to V_{REF} 30 + 40, if requested
2-1/2 miles from FAF	<p>"GEAR DOWN, FLAPS 20, REF 20, LANDING CHECKLIST"</p>	<ul style="list-style-type: none"> • Position gear lever DOWN • Select flaps 20 • Set command airspeed cursor to V_{REF} 30 + 20, if requested • Initiate Landing Checklist
1/2 mile prior to FAF	<p>"FLAPS 30, REF 5"</p> <ul style="list-style-type: none"> • Set/Request MDA or MDA Buffer Altitude 	<ul style="list-style-type: none"> • Select flaps 30 • Set command airspeed cursor to V_{REF} 30 + 5, if requested • Set altitude, if requested

Designates which crewmember performs action or callout

Triggering event

Callout

Action

Organization lacks adequate SOPs

**Shuttle America
February 18, 2007
Cleveland, Ohio**



Problems with fatigue policy

- Specific details of the policy were not documented in writing and were not clearly communicated to pilots
- These “shortcomings” limited the effectiveness of the policy

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Implications

- “Shuttle America’s failure to administer its attendance policy as written might have discouraged some of the company’s pilots, including the accident captain, from calling in when they were sick or fatigued because of concerns about the possibility of termination.”

Why SOPs are not followed

ORGANIZATIONS DON'T ADHERE TO THEIR SOPS

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Cessna 310, N501N
July 10, 2007
Sanford, FL
5 fatalities





Declared Emergency

“Smoke in the cockpit.”

“Shutting off radios, elec.”



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Maintenance Discrepancy Entry

AIRCRAFT: N501N	DATE: 07-09-07	-ACTT	
MAINTENANCE WRITE-UP		-ACTL	
Entered By: ACT	Location: DAB	<input type="checkbox"/> Repaired	<input type="checkbox"/> Replaced
		<input type="checkbox"/> Released- Could Not Duplicate	<input type="checkbox"/> Loaner Installed
RADAR WENT BLANK DURING CRUISE FLIGHT. RECYCLED - NO RESPONSE... <u>SMELL OF</u> <u>ELECTRICAL COMPONENTS BURNING</u> TURNED OFF UNIT - PULLED RADAR C.B. - SMELL WENT AWAY. - RADAR INOP		Corrective Action:	

**“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.”

- “NASCAR 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

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**US Airways Express
January 19, 2010
Charleston, WV**

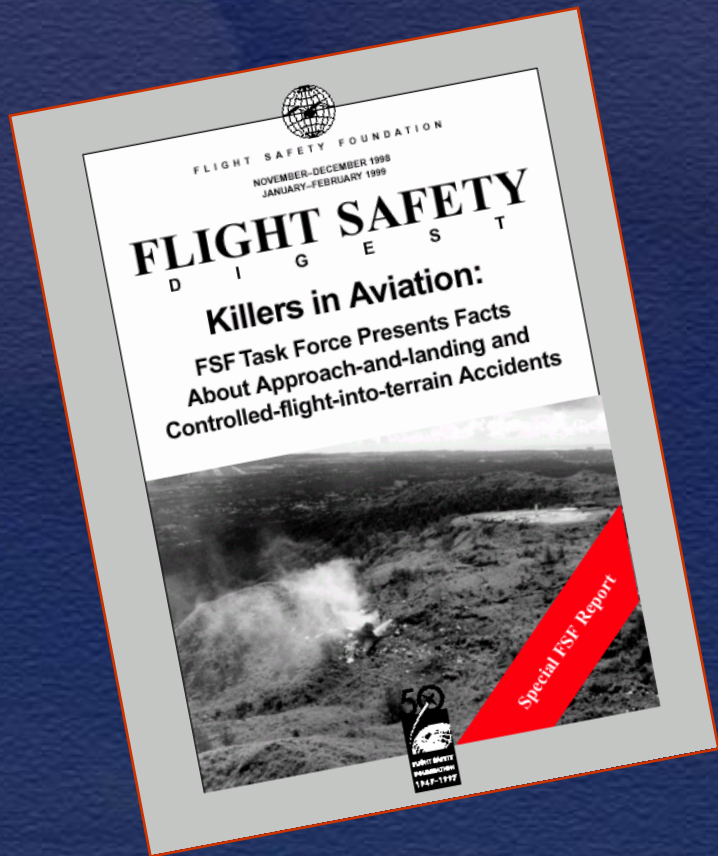


Probable cause:

- “...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 noncompliance leads to other problems

- LOSA data revealed that, compared to crews who followed SOPs, crewmembers who intentionally deviated from procedures:
 - averaged making three times more errors
 - mismanaged more errors
 - found themselves in more undesired aircraft situations.

Establishing a culture of procedural compliance

- Realize that well-designed SOPs are essential for safety.
- Merely having the procedures is not enough – the organization and front line personnel must religiously follow those procedures in order for them to be effective.
- Management should establish that procedural compliance is a core value of the organization and insist on compliance.

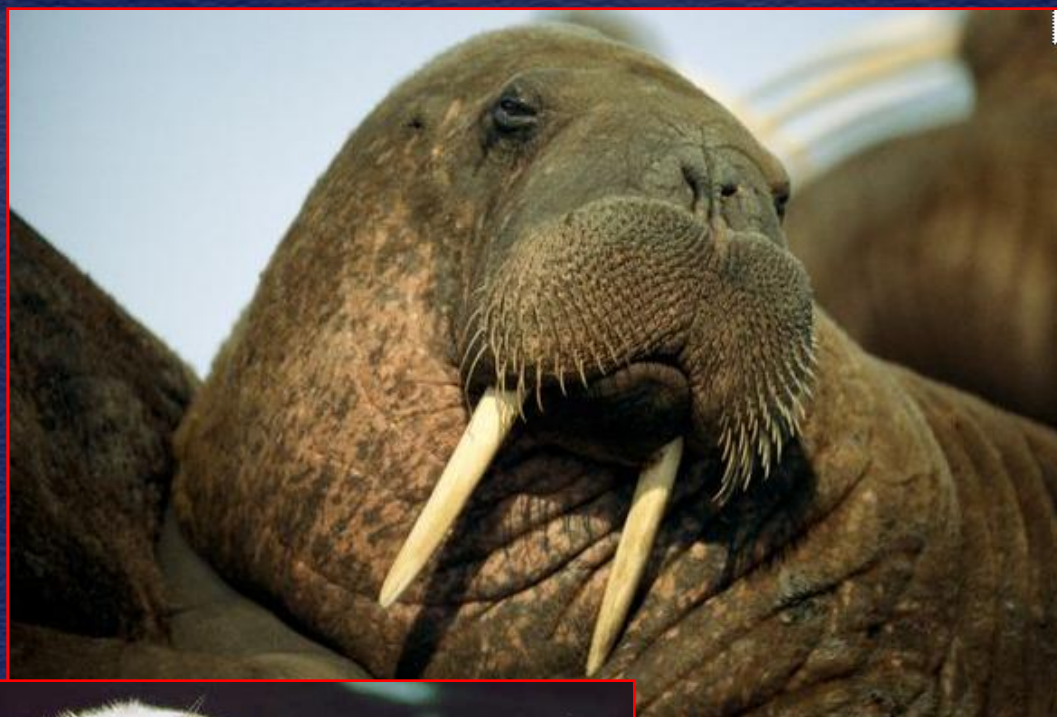


Establishing a culture of procedural compliance

- 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.



Seals, sea otters, and walruses



Seals, sea otters, and walruses



Deepwater Horizon

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Seals, sea otters, and walruses

Deepwater Horizon



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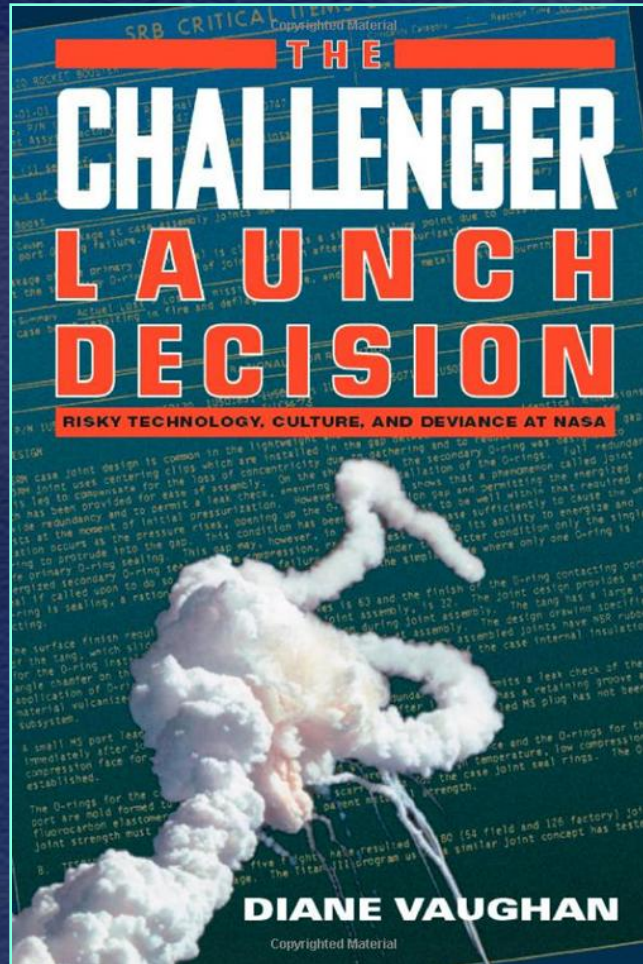
Seals, sea otters, and walruses

BP Spill Response Plan for Deepwater Horizon at that 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 names and phone numbers for marine life specialists in Texas
- Listed spill response companies that no longer existed
- Listed instructions for how to deal with seals, sea otters, and walruses
 - None of these mammals even live in the Gulf of Mexico



“Normalization of deviance”



- When not following procedures and taking “short cuts” and becomes an accepted practice.

Audit

- Internally audit procedures.
 - Eliminate those that don't make sense or don't work.
- 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

- SOPs are most effective when “the procedures make sense to the pilots and they feel they have a stake in the formation of the procedures. To get buy-in from the crews, it is extremely important that these procedures be reviewed on a regular basis and that there is line pilot input” (Tullo, 2010, p. 70).



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