Controlled Flight Into Terrain (CFIT)

The Problem That Never Went Away

Robert Sumwalt
US National Transportation Safety Board
Gulfstream GII Accident

September 26, 1976            Hot Springs, Virginia
11 Fatalities
Cessna 401 Accident

October 24, 1976  Hot Springs, Virginia  0 Fatalities
A great CFIT resource!
When an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew.

Source: CFIT Training Aid
In the past 3 ½ years:

• CFIT has claimed over 500 lives in worldwide airplane crashes
  – In the vast majority of these crashes, the aircraft was not equipped with an operational TAWS.
Fatalities by CAST/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories


Source: Boeing
# CFIT Accidents: 2014

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
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Source: Don Bateman (Honeywell); NTSB files; Jim Burin (Flight Safety Foundation)
## CFIT Accidents: 2013

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## CFIT Accidents: 2011

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</table>
Since January 1, 2008 – present:
- 22 Helicopter CFIT accidents in US
- 37 Fatalities
Don Bateman
Terrain Warning and Alerting System (TAWS)
TAWS

- Worldwide terrain database
- Through GPS and FMS, the system knows aircraft position and altitude
- Scans ahead to check for terrain threats
- Provides aural and visual WARNINGS/CAUTIONS up to 60 seconds before predicted terrain conflict
Probable Cause

- The pilot's failure to maintain a safe ground track and altitude combination for the moonless night visual flight rules flight, which resulted in controlled flight into terrain.
- Contributing to the accident were the pilot's complacency and lack of situational awareness and his failure to use air traffic control visual flight rules flight following or minimum safe altitude warning services.
- Also contributing to the accident was the airplane's lack of onboard terrain awareness and warning system equipment.
A Threat & Error Management (TEM) Approach to Reducing CFIT
“Threats”

- Those things that can increase the operational complexity, and if not handled correctly, can decrease the safety margins

- Weather
- Delays
- Mechanical Malfunctions
- Stress
- Time pressure
- Distractions
- ???
Threats

- Threats can increase error potential
- Threats “put holes in” or weaken our barriers against error

Threats = Red Flags
Be aware of threats!

- “Snakes in the grass”
  - What are the things that can bite you on this flight?
- We want crewmembers to identify, talk about and think about threats, and
- those things that are different about this operation or flight
  - Unfamiliar airport
  - Flying with new pilot
  - New procedures
- This puts the threats in the employees “mental RAM” and makes it readily available for retrieval
  - Example: mentally rehearse CFIT escape maneuver
Errors
USA TODAY

NO. 1 IN THE USA . . . FIRST IN DAILY READERS

FIRST IN A 3-PART SERIES

WARNING: PILOT ERROR

How regional airlines failed to heed warning signals about pilots who didn't belong in the cockpit
“To err is human”

“Errar e humano”
Why error management?

• Traditional thinking focused on eliminating human error in aviation
• Contemporary thinking acknowledges that error is a way of life
  – given the acceptance that human error may occur, the focus has become “How do you effectively manage error?”
  – proper error management greatly enhances safety
Errors will occur

“So we must create an error management system in which the crew recognizes and corrects errors before negative consequences occur.”

- Captain Frank J. Tullo
  “Aviation Week and Space Technology”
  May 21, 2001
Threat and Error Management

Helps us avoid and trap errors.
Avoiding Errors

• Good training
• High levels of proficiency
• Following SOPs
• Minimizing distractions
• Planning ahead
• Maintaining situational awareness
• CRM – the effective use of all available resources
Trapping Errors

• Once an error is committed, it is difficult to catch (trap) your own error
• Other people are often more likely to catch your error
• Therefore, redundancy is one strong defense against error
Layers of Defense (barriers) to trap crew errors

- Onboard Alerting Equipment
- External Alerting, i.e., ATC
- PNF/PM
- Pilot Flying
Examples of how “holes in defenses” can be formed

- Increasing workload
- Time pressure
- Fatigue
- Procedural non-compliance
- Poor crew coordination
- Interruptions / Distractions
Layers of defense help deflect errors from becoming hazards.

Error

Error Trapped. Hazard Averted
Learjet 35A
October 24, 2004
San Diego, CA
5 Fatalities
SAN DIEGO, CA
BROWN FIELD MUNI

DEPARTURE PROCEDEURE: Rwys 8L,8R, climbing left turn. Rwys 26L,26R, climbing right turn. All aircraft climb heading 280° to intercept MZB R-160 northwestbound to MZB VORTAC.
Holes in defenses

- Captain decides to depart without IFR clearance
- F/O does not get weather
- No TAWS
- ATC does not issue MSAW
- Error - crew does not follow terrain avoidance procedure
- Captain decides to depart without IFR clearance
Probable Cause

The failure of the flight crew to maintain terrain clearance during a VFR departure, which resulted in controlled flight into terrain; and,

The air traffic controller’s issuance of a clearance that transferred the responsibility for terrain clearance from the flight crew to the controller, failure to provide terrain clearance instructions to the flight crew, and failure to advise the flight crew of the MSAW alerts.
Contributing Factors

Contributing to the accident was the pilots’ fatigue, which likely contributed to their degraded decision-making.
Threat and Error Management ABCD’SS

Acknowledge that we are error prone
Threat and Error Management ABCD’SS

• This does not mean that errors are okay
  – Naturally we would prefer not to make them
  – However, the reality is that we will make mistakes, so acceptance and awareness are vital

• Acknowledge that threats can affect performance

Acknowledge errors
Threat and Error Management ABCD’S

Maximize Barriers
Realize the importance of redundancies

• Keep as much redundancy in the operation, for as long as possible

• Plan best time for being “out of the loop” (split cockpit)
  – lowest workload
  – least risk

• Both pilots “cross-verify” critical checklist items (“killer items”) and ATC clearances
Flight Crew Example:

- Climbing out of 10,000 feet, with clearance to 12,000
  - Timing of “10,000 foot announcement”

Maximize Barriers
Planing and awareness are the keys

• We’re not saying don’t do these things - obviously you must do them
• The point is to PLAN them (when able) to conduct them during lowest workload, least risk periods
• We realize that not everything can be planned, so when one pilot is out of loop, be very aware of reduced redundancy

Maximize Barriers
Threat and Error Management ABCD’SS

Communicate
Threats and Intentions Effectively
Communicate

Anything that can:

• Reduce your ability to detect errors
• Anything that can increase your chance of making errors
Communicate threats

• “Snakes in the grass”
  - What are the things that can bite you on this flight or operation?
  - Identify, discuss and think about these things (threats) and those that are different about this operation
Ways communications can be improved

- Research shows that the way a crew communicates can be a predictor of the way that the crew performs.
  - Crews who communicated better were those crews who made fewer errors.
Improving communications

- Improved performance (i.e., fewer errors) was associated with crews who showed increased number of:
  - commands
  - inquiries
  - acknowledgements
  - verbal observations about flight status

- Foushee & Manos (1981)
“Hint and Hope”

• Someone drops a subtle hint, hoping the other person will get the message
  – Ineffective
  – Very Risky

Communicate
Effective Assertion Model

1. Opening
2. Statement of Concern
3. State the problem
4. Propose a solution
5. Achieve agreement

Pilot Example: Robert, I’m concerned. There is high terrain to the east. I think we should get our IFR clearance before we depart. What do you think?
Threat and Error Management ABCD’S

Distractions and Interruptions
Distractions & Interruptions can form “holes in defenses”
Distractions & Interruptions are Red Flags

- Treat Distractions and Interruptions as Red Flags

Manage Distractions
“Interruptions Always Distract”

**I A D**

**Identify** – the interruption

**Ask** – what was I doing before being interrupted?

**Decide** – what action to take to get back on track
Threat and Error Management ABCD’Ss

Follow SOPs

Standard Operating Procedures
Accident Prevention Strategies

Hull-loss Accidents over 10 Year Period

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Source: Boeing study of accident prevention strategies
# Accident Prevention Strategies

## Hull-loss Accidents over 10 Year Period

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### Source: Boeing study of accident prevention strategies
How SOPs relate to error

• Line Operations Safety Audit (LOSA) data show that crews who intentionally erred by not following SOPs were 3 times more likely to commit another error with consequential results.

• “Normalization of Deviance”

Follow SOPs
Standard Operating Procedures

• SOPs establish a consistent baseline for performance

• Because the baseline is established, deviations from it can be identified easier
  – “Hmm, I don’t usually miss things like that.”

• Allows crewmembers to concentrate on issues not covered by SOPs

Follow SOPs
Threat and Error Management ABCD’S’S

Sensible?
Sensible?

• Ask yourself and make sure that what you are doing (and are about to do) is sensible
Threat and Error Management ABCD’S S

A  Acknowledge
B  Barriers
C  Communicate
D  Distractions
S  SOPs
S  Sensible
Learn...

- CFIT is still a safety problem!
- A good defense against CFIT is having an operational TAWS with latest software updates.

Apply...

- TAWS is not the absolute answer.
- Practice ABCD’s of Threat and Error Management.

Share...

- Share this message with those that you fly with and your co-workers.