NTSB National Transportation Safety Board

SMS:
What the heck is it, anyway?

Robert L. Sumwalt

July 10, 2007, Sanford, FL

- Cessna 310 owned by NASCAR
- Flight planned Daytona Beach to Lakeland
- 5 fatalities

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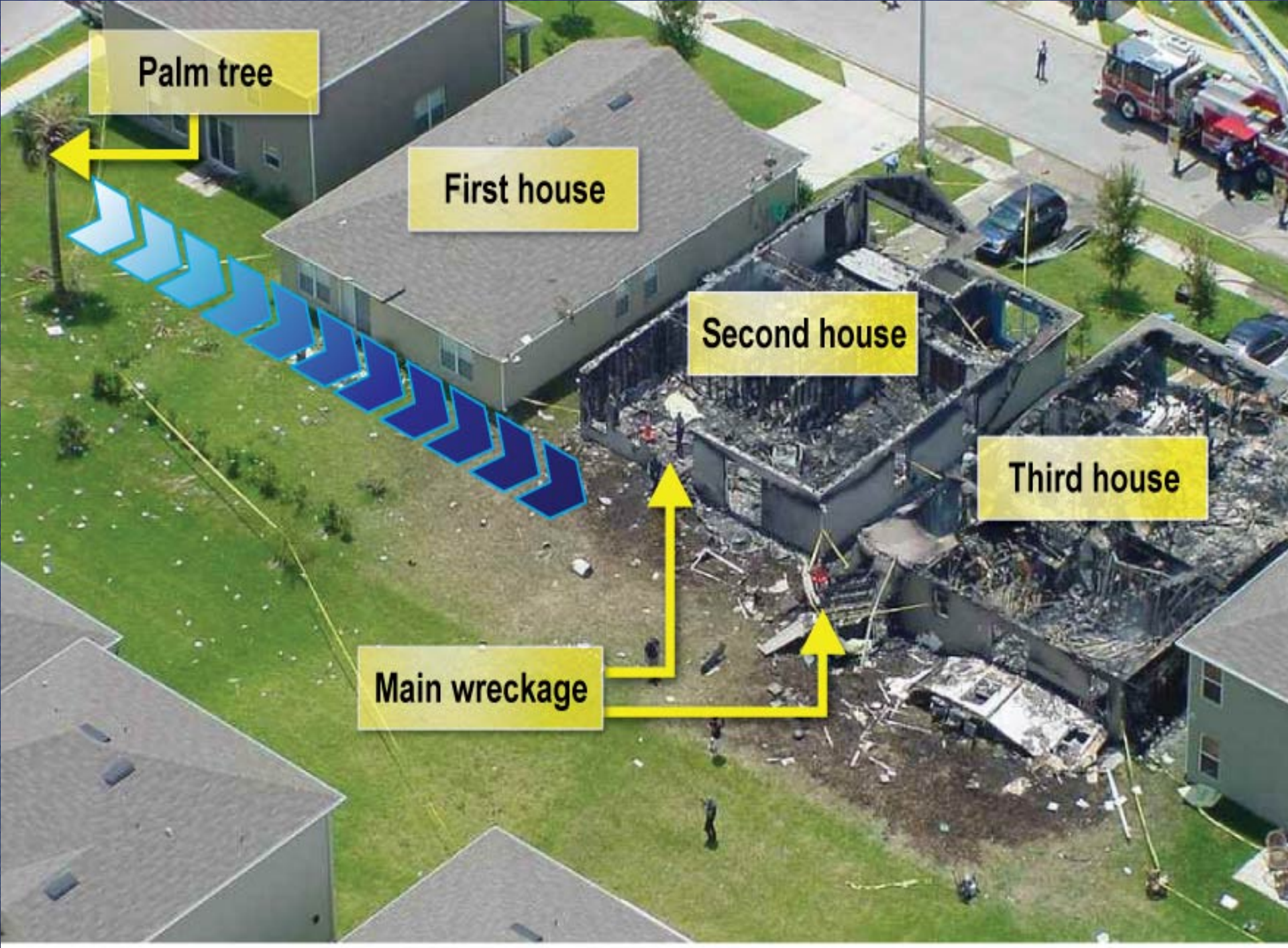
Palm tree
First house
Second house
Third house
Main wreckage

Declared Emergency

“Smoke in the cockpit.”

“Shutting off radios, elec.”

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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."

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NTSB Finding

"Safety Management System programs would provide corporate flight departments a formal system of risk management, safety methods, and internal oversight programs that could improve safety."

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NTSB Recommendation to FAA

Develop a safety alert for operators encouraging all Part 91 business operators to adopt Safety Management System programs that include sound risk management practices.

– NTSB Recommendation A-09-16

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NTSB Recommendations to FAA

- Require that all Part 121 operators establish Safety Management System programs.
  - NTSB Recommendation A-07-10

– Require helicopter EMS operators to implement a SMS program that includes sound risk management practices.
  - NTSB Recommendation A-09-89

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Other NTSB Recommendations for SMS

Marine Industry

Rail Industry

Pipeline Operators

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What is a Safety Management System?

"A SMS is an organized approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures."

"An effective safety management system program can help companies reduce and prevent accidents and accident-related loss of lives, time, and resources."

- From NTSB report of CN derailment, page 83

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What's in a name?

- Safety Management Systems
  - "Something you have"

- Safety Management
  - "Something you do"

  - From Don Arendt, Ph.D., FAA

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SMS…

Is a business approach to managing safety.

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When you have SMS, the company …

- **Systematically** attends to those things it believes are important.

- Manages and values safety, just as they manage and value other vital business functions.

  - **Finance:** CFO, General Accepted Accounting Practices (GAAP), procedures, controls, audits, accountability

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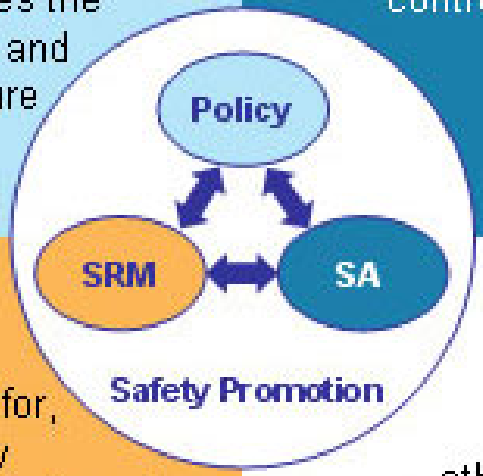
The Four SMS Components

Safety Policy

Establishes senior management's commitment to continually improve safety; defines the methods, processes, and organizational structure needed to meet safety goals

Safety Assurance

Evaluates the continued effectiveness of implemented risk control strategies; supports the identification of new hazards



Safety Risk Management

Determines the need for, and adequacy of, new or revised risk controls based on the assessment of acceptable risk

Safety Promotion

Includes training, communication, and other actions to create a positive safety culture within all levels of the workforce

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SMS Components

1. Written policies, procedures and guidelines
2. Data collection and analysis
3. Risk management
4. Safety culture

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SMS Components

1. Written policies, procedures, guidelines

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Potential Gaps

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

– or –

- They don’t rigorously adhere to what they do have.

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SMS Components

2. Data collection and analysis

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Data leads to informed Risk Management

- “Hazards and incidents resulting from department operations shall be identified at all levels.

- “Conditions and acts posing unacceptable risk shall be eliminated or changed to prevent personal injury or illness and property damage or loss.”

  – NBAA Prototypical Safety Manual

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SMS Components

3. Risk Management

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Risk Management

"We manage risk whenever we modify the way we do something to make our chances of success as great as possible, while making our chances of failure, injury or loss as small as possible."

– FAA System Safety Handbook

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Risk Management

1. Identify Hazards
2. Assess Risk
3. Control (mitigate) Risks
4. Measure Effectiveness of Controls

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Risk Management

1. Identify Hazards
2. Assess Risk
3. Control (mitigate) Risks
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What is a hazard?

- Any existing or potential condition that can lead to injury, illness, or death; damage to or loss of a system, equipment, or property.

- A condition that might cause (is a prerequisite to) an accident or incident.

- Source: FAA AC 120-92A

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Step 1: Identify Hazards

HAZARDS

- No operational tower

- No precision approach

Flight Safety Foundation

ALAR Tool Kit

Approach-and-Landing Accident Reduction

Approach-and-landing Risk Awareness Tool

Airport Services and Equipment

- No approach radar service or airport tower service
- No current local weather report
- Unfamiliar airport or unfamiliar procedures
- Minimal or no approach lights or runway lights
- No visual approach-slope guidance — e.g., VASI/PAPI
- Foreign destination — possible communication/language problems

Expected Approach

- Nonprecision approach — especially with step-down procedure or circling procedure
- Visual approach in darkness
- Late runway change
- No published STAR

What are the potential consequences of this hazard?

Risk Management

1. Identify Hazards
2. Assess Risk
3. Control (mitigate) Risks
4. Measure Effectiveness of Controls

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What is risk?

- A composite depiction of probability that a hazard will manifest itself in a mishap, and the severity of the mishap, should the mishap occur.

- Risk = Probability x Severity

Step 2: Assess Risk

PROBABILITY

SEVERITY	Unlikely	Seldom	Occasional	Likely
Catastrophic	2	3	4	4
Critical	1	2	3	4
Marginal	1	1	2	3
Negligible	1	1	2	2

Hazard Severity

Catastrophic - Death or permanent total disability, system loss, major damage, significant property damage, mission failure.

Critical - Permanent partial disability, major system damage, significant property damage, significant mission degradation.

Marginal - Minor injury, lost workday accident, minor system damage, minor property damage, some mission degradation.

Negligible - First aid or minor medical treatment, minor system impairment, little/no impact on mission accomplishment.

MIL-STD-882D: Example of Mishap Severities

Description	Category	Environmental, Safety, and Health Result Criteria
Catastrophic	I	Could result in death, permanent total disability, loss exceeding $1M, or irreversible severe environmental damage that violates law or regulation.
Critical	II	Could result in permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, loss exceeding $200K but less than $1M, or reversible environmental damage causing a violation of law or regulation.
Marginal	III	Could result in injury or occupational illness resulting in one or more lost work days(s), loss exceeding $10K but less than $200K, or mitigatible environmental damage without violation of law or regulation where restoration activities can be accomplished.
Negligible	IV	Could result in injury or illness not resulting in a lost work day, loss exceeding $2K but less than $10K, or minimal environmental damage not violating law or regulation.

Hazard Probability

Likely - Occurs several times.

Occasional - Occurs sporadically

Seldom - May occur at some time

Unlikely - Can assume it will not occur

MIL-STD-882D: Example of Mishap Probabilities

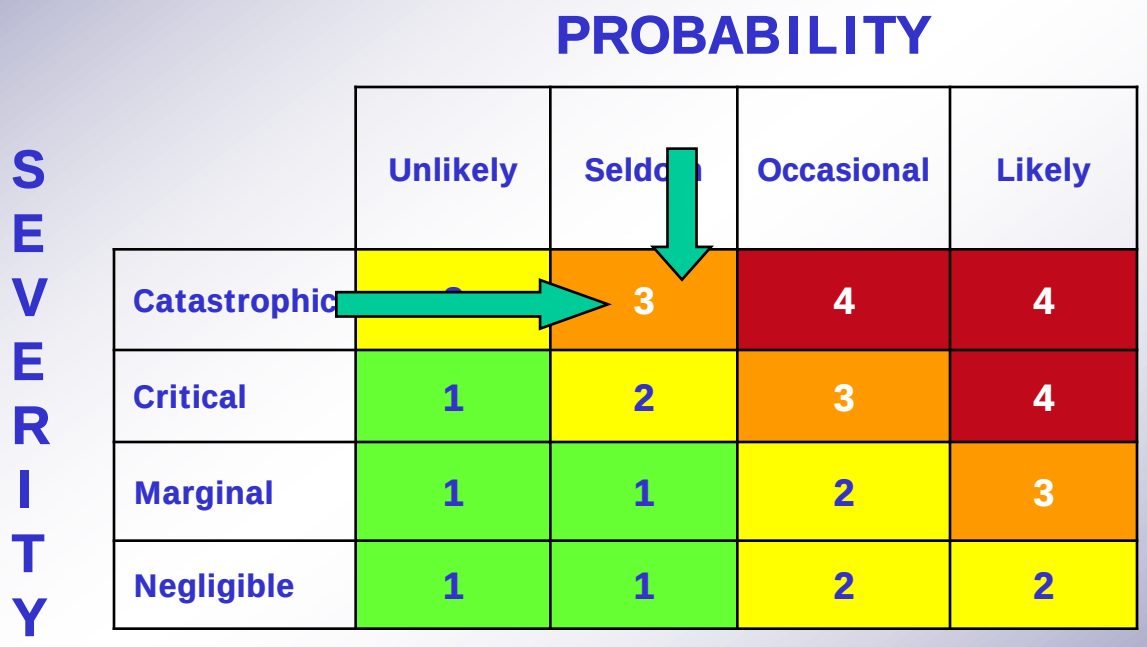
Description*	Level	Specific Individual Item	Fleet or Inventory**
Frequent	A	Likely to occur often in the life of an item, with a probability of occurrence greater than 10^{-1} in that life.	Continuously experienced.
Probable	B	Will occur several times in the life of an item, with a probability of occurrence less than 10^{-1} but greater than 10^{-2} in that life.	Will occur frequently.
Occasional	C	Likely to occur some time in the life of an item, with a probability of occurrence less than 10^{-2} but greater than 10^{-3} in that life.	Will occur several times.
Remote	D	Unlikely but possible to occur in the life of an item, with a probability of occurrence less than 10^{-3} but greater than 10^{-6} in that life.	Unlikely, but can reasonably be expected to occur.
Improbable	E	So unlikely, it can be assumed occurrence may not be experienced, with a probability of occurrence less than 10^{-6} in that life.	Unlikely to occur, but possible.

Step 2: Assess Risk

HAZARDS

-No operational tower
- No precision approach

Step 2: Assess Risk



Risk Management

1. Identify Hazards
2. Assess Risk
3. Control (mitigate) Risks
4. Measure Effectiveness of Controls

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Ways we can deal with risk

- Accept the risk
- Transfer risk
- Share risk
- Eliminate it
- Mitigate it

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Step 3: Control (mitigate) Risk

HAZARDS

- No precision approach
- No operational tower

LEADING TO CFIT

CONTROLS

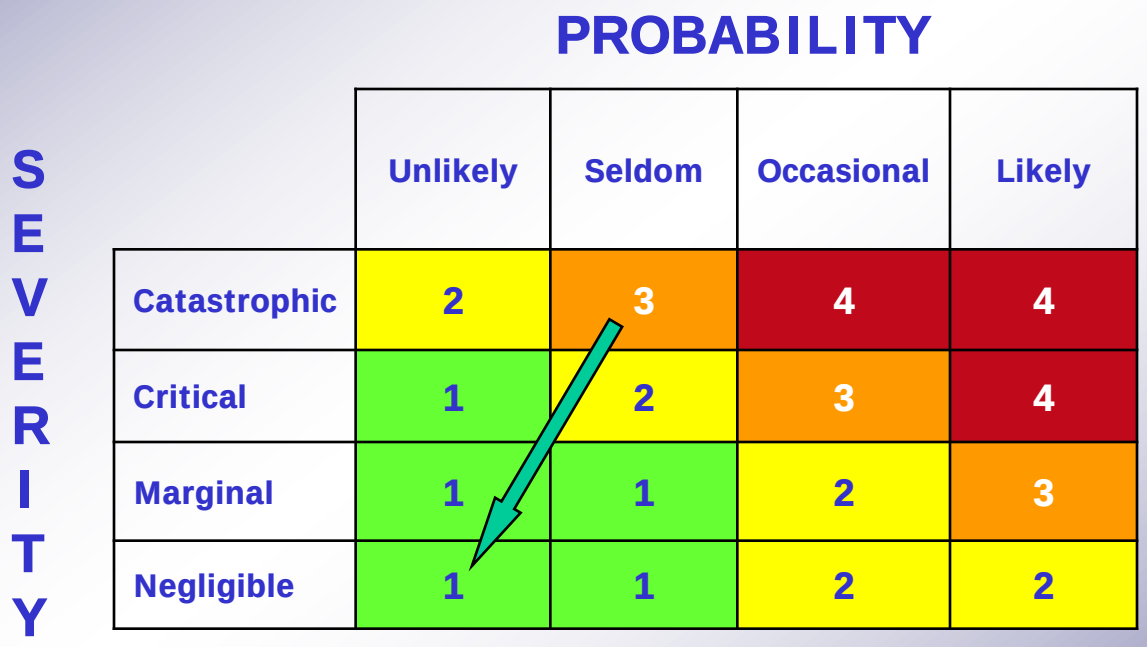
We will not use this airport:

– at night (when control tower is closed)

AND

– when weather is forecast below 800/2.

Determining Residual Risk



Hazard	RAC
No precision approach	1 (Unlikely, Negligible)
No operational tower	1 (Unlikely, Negligible)

Determining Residual Risk

PROBABILITY

SEVERITY

	Unlikely	Seldom	Occasional	Likely
Catastrophic	2	3	4	4
Critical	1	2	3	4
Marginal	1	1	2	3
Negligible	1	1	2	2

Hazard	RAC
No precision approach	2 (Unlikely, Catastrophic)
No operational tower	2 (Unlikely, Catastrophic)

Risk Management

1. Identify Hazards
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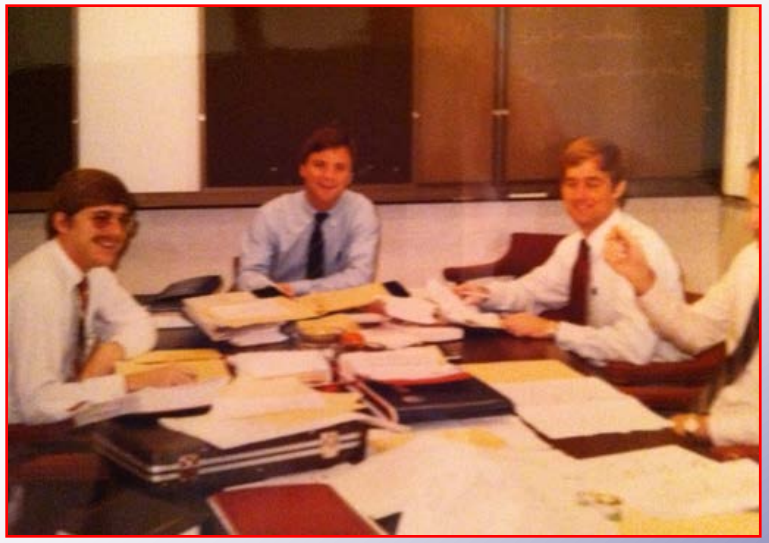
Step 4: Measure Effectiveness of Controls

- Continually reassess to ensure that what you're doing is actually working.



How Much to Risk Reduce?

- ALARP = As Low As Reasonably Practicable

- Different than as low as possible.

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What is the best order for these?

Incorporate Guards/Safety Devices

(Guards put up to decrease exposure)

Eliminate the hazard through Design

(Hazard is corrected and eliminated)

Develop Procedures and Training

Provide Warning Devices

(Warn personnel if you can't eliminate or control the hazard)

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Hierarchy of Controls*

1. Eliminate the hazard through Design
   - Hazard is corrected and eliminated
2. Incorporate Guards/Safety Devices
   - Guards put up to decrease exposure
3. Provide Warning Devices
   - Warn personnel if you can't eliminate or control the hazard
4. Develop Procedures and Training

*Also know as "Safety Order of Precedence"

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Make Risk Decisions at the Appropriate Level

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SMS Components

4. Safety Culture

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Why safety culture?

- “The NTSB has on a number of occasions recognized the lack of an organizational culture of safety within a transportation agency as having contributed to an accident.”
  - NTSB report of WMATA accident, p. 98

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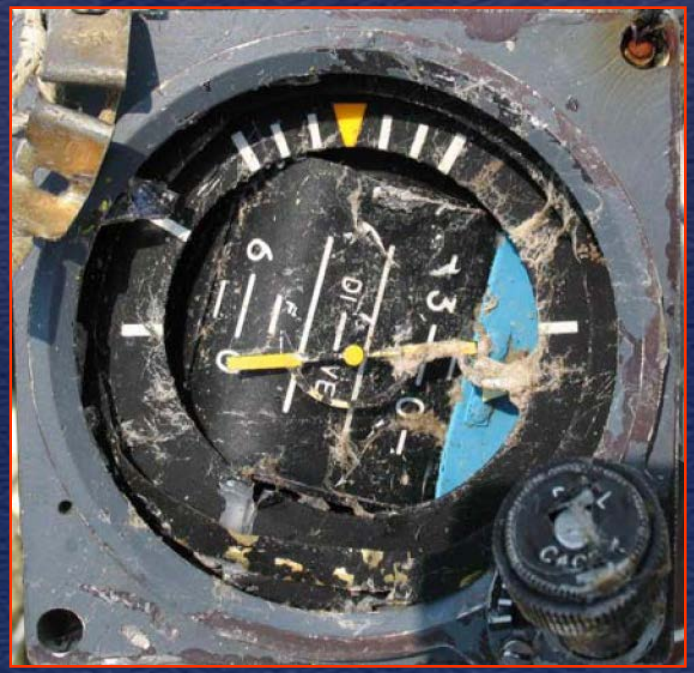
June 4, 2007



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What the investigation found

Captain/chief pilot/check airman

- had prior certificate revocation
- routinely failed to comply with procedures and regulations
- falsified training records

Marlin Air

- had financial difficulties
- did not ensure those who operated their aircraft were properly trained.

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NTSB Finding

- "Marlin Air's selection of the accident captain (who routinely failed to comply with procedures and regulations) to the positions of company chief pilot and check airman, with responsibility for supervision and training of all company pilots, contributed to an inadequate company safety culture that allowed an ill-prepared first officer to fly in Part 135 operations."

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NTSB Finding

- "Marlin Air's selection of the accident captain (who routinely failed to comply with procedures and regulations) to the positions of company chief pilot and check airman, with responsibility for supervision and training of all company pilots, contributed to an inadequate company safety culture that allowed an ill-prepared first officer to fly in Part 135 operations."

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Do you have a good safety culture?

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Do you have a good safety culture?

- "… it is worth pointing out that if you are convinced that your organization has a good safety culture, you are almost certainly mistaken."
- " … a safety culture is something that is striven for but rarely attained…"
- "…the process is more important than the product."

- James Reason, "Managing the Risks of Organizational Accidents."

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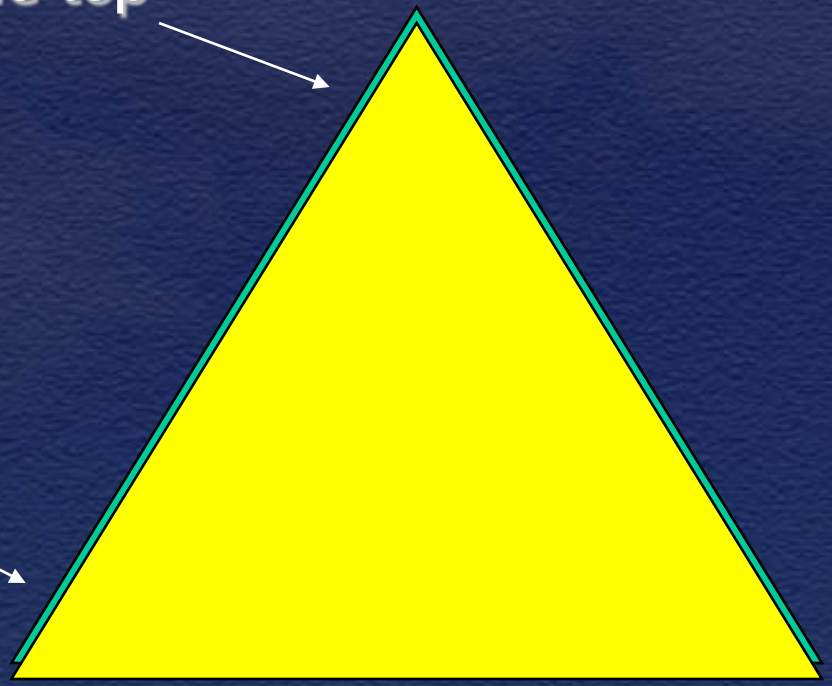
Safety Culture is:

Triggered at the top

Measured at the bottom



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

Safety Culture

Doing the right things, even when no one is watching.

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Safety culture

"Safety culture is the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment."

Source: U.S. Nuclear Regulatory Commission

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Roadmap to Safety Culture

1. Management Commitment and Emphasis
2. Personal Accountability and Empowerment
3. Culture of Compliance
4. Continuous Learning and Risk Awareness
5. Just Culture
6. Questioning Attitude

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From NTSB report of WMATA Accident

- "Organizations with effective safety cultures are generally described as having a commitment to safety that permeates the entire organization; that is, senior management demonstrates a commitment to safety and a concern for hazards that are shared by employees at all levels within the organization." (p. 98)

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Roadmap to Safety Culture

Management commitment and emphasis on safety

- Safety begins at top of organization
- Safety permeates the entire operation

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Roadmap to Safety Culture

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Personal accountability

- Employees recognize their role in safety promotion and actions, and hold themselves and others accountable. (NRC, 2011)
- Employees have a substantial voice in safety decisions, and have the leverage to initiate and achieve safety improvements. (Wiegman, et al, 2002)

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A Culture of Compliance

- Internal company policies, procedures, rules
- Ethical principles
- Company code of conduct
- Federal, state, and local laws and ordinances
- Industry best practices
- Financial guidelines and principles
- Et cetera

A commitment to doing things right.
Always.

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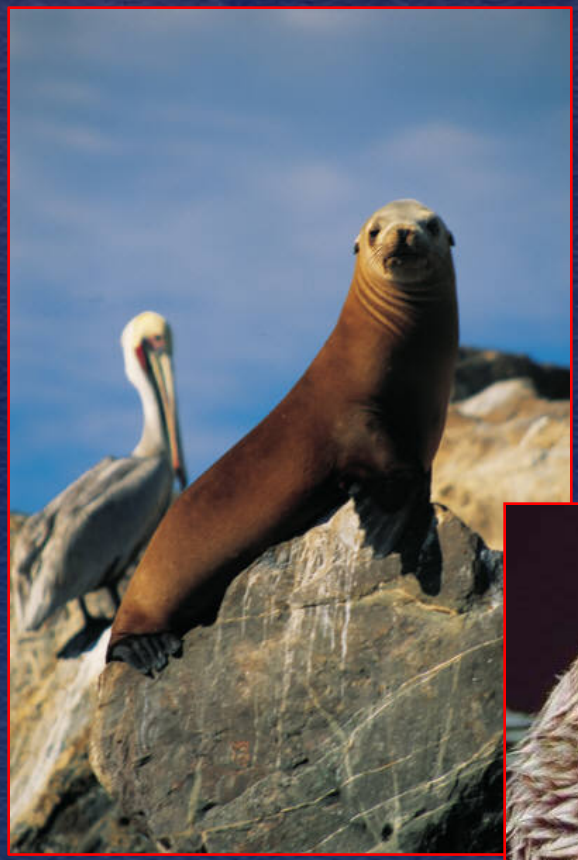
Establishing a Culture of Compliance

- Procedures must not be developed in a vacuum - they must have the input of those who are expected to use them.
- It is critical that employees 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



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Avoid seals, sea otters, and walruses

Deepwater Horizon

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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 at Texas A&M
- Listed instructions for how to deal with seals, sea otters, and walruses
  - **None of these mammals even live in the Gulf of Mexico**

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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.

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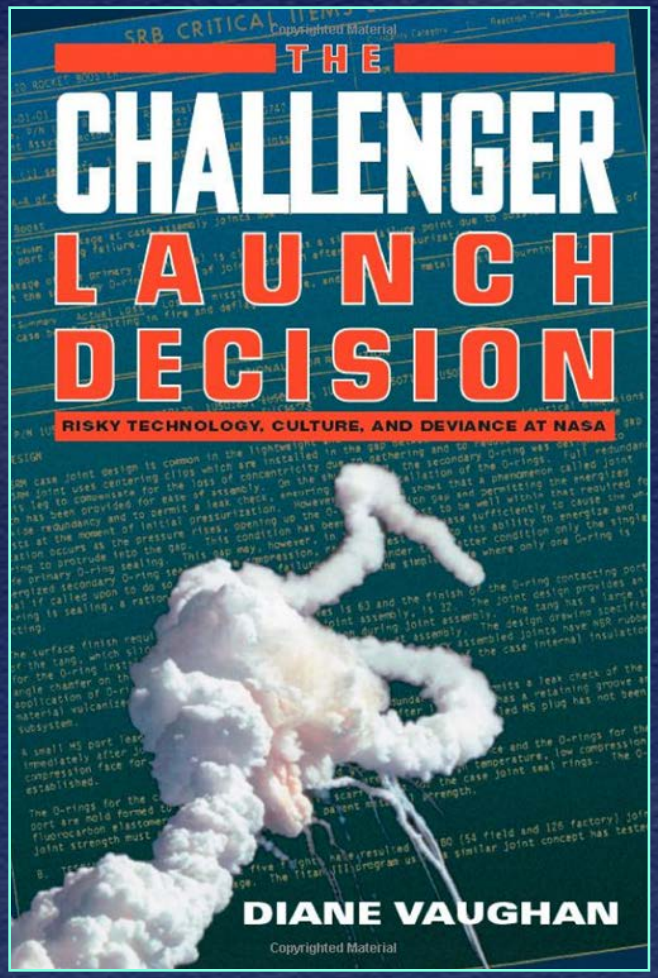
Avoid “Normalization of Deviance”



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

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Avoid Selective Compliance

- "That is a stupid rule."
- "I don't have to comply with that one."

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Continuous Learning and Risk Awareness

- Organizations with a healthy safety focus are constantly learning.
- They actively seek ways to improve safety.
- They learn from their mistakes and those of others.
- Information regarding prior incidents and accidents is shared openly and not suppressed.
- They are ever mindful of risks and are looking for ways to mitigate those risks.

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Continuous Learning and Risk Awareness

- “The best way to assess the health of safety-critical systems is through active monitoring and evaluation of operations and equipment in search of ‘leading indicators’ of system problems.”

- “Examples of leading safety indicators include:
  - recorded operational data
  - the results of inspections
  - safety audits
  - and employee reports of safety concerns and near-miss events.”

Source: NTSB report of Washington, DC subway collision, p. 103

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Measure the right things

- Are you measuring the right things?
- Are they the most appropriate predictors of catastrophic events?

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How do you stay informed?

- Internal safety audits
- External safety audits
- Confidential incident reporting systems
- Employee feedback
- MBWA (Management By Walking Around)

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Keeping Fingers on the Pulse

- How do you detect and correct performance deficiencies before an accident?
- How do you keep your finger on the pulse of your operations?
- Do you have multiple data sources?

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Employees

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Are employees comfortable reporting?

- Employees are open to report safety problems, if they receive assurances that:
  - The information will be acted upon
  - Data are kept confidential or de-identified
  - They will not be punished or ridiculed for reporting
    - Non-reprisal policy signed by CEO

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Non Reprisal Policy
December 2005

SCANA Aviation Department is committed to the safest flight operation possible. Therefore, it is imperative that we have uninhibited good faith reporting of any hazard, occurrence or other information that in any way could enhance the safety and efficiency of our operations. It is each employee's responsibility to communicate any information that may affect the integrity of flight safety.

We will not use this reporting system to initiate disciplinary proceedings against an employee who discloses in good faith a hazard or occurrence involving safety that is the result of conduct which is inadvertent, unintentional or not deliberate.

disciplinary proceedings against an employee who discloses in good faith a hazard or occurrence involving flight safety which is the result of conduct which is inadvertent, unintentional or not deliberate.

We urge all employees to use this program to help this Department be a leader in providing our passengers and our employees with the highest level of flight safety.

William B. Timmerman
Chief Executive Officer

Robert L. Sumwalt, III
Manager – Aviation

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"Just" Culture

- Employees realize they will be treated fairly
  - Not all errors and unsafe acts will be punished (if the error was unintentional)
  - Those who act recklessly or take deliberate and unjustifiable risks will be punished

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Just Culture

"An atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior."

- James Reason, Ph.D.

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Questioning Attitude

- Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action.

- Encourages employees to cultivate a questioning attitude and set up necessary open communication between line workers and middle and upper management.

Source: U. S. Nuclear Regulatory Commission

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Do you have a good safety culture?

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SMS Components

1. Written policies, procedures and guidelines
2. Data collection and analysis
3. Risk management
4. Safety culture

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Finally…

- The lifeblood of SMS is data – using data to inform you of what is going on in your organization.
- The heart of SMS is a process of continuous improvement.
- The soul of SMS is having a safety culture.

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