NTSB National Transportation Safety Board
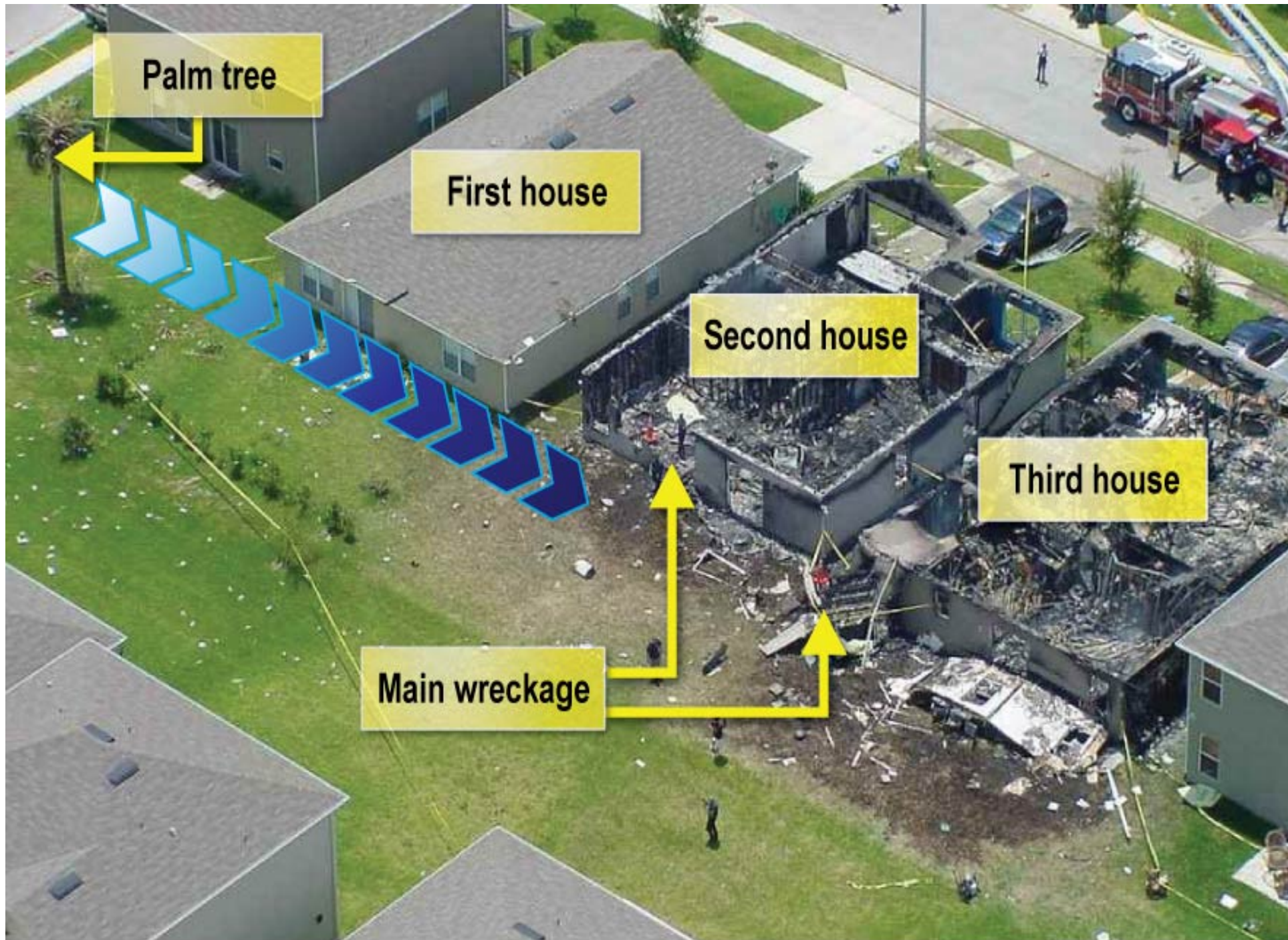
SMS:
What is it anyway?

Robert L. Sumwalt

SMS

July 10, 2007, Sanford, FL

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

NTSB

Palm tree

First house

Second house

Third house

Main wreckage

Declared Emergency

"Smoke in the cockpit."

"Shutting off radios, elec."

NTSB

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

07/11/2007

NTSB

Maintenance Discrepancy Entry

Events - Previous Day

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

Events - Accident Day

- Maintenance technician did not examine binder or airplane

- ATP dismissed radar issue as unimportant

- Pilots accepted airplane "as is"

- Weather radar circuit breaker likely reset for the flight

NTSB

Organizational Processes

- Limited grounding authority
- Forms not serialized, tracked, or retained
  - Yellow copy never provided
- SOP guidance versus reality
- No assurance discrepancies would be addressed
- Airworthiness status unclear

NTSB

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."

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."

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

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

NTSB

What is a Safety Management System?

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

– *ICAO (Doc 9859 SMM)*

When you have SMS, the company …

- **<u>Systematically</u>** 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

NTSB

SMS Components

1. Written policies, procedures and guidelines

2. Data collection and analysis

3. Risk management

4. Safety culture

NTSB

SMS Components

1. Written policies, procedures, guidelines

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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Inadequate Procedures

07/11/2007

Inadequate Procedures

- No specific procedure for the director of maintenance to communicate maintenance status of an aircraft to anyone else within NASCAR.

- No procedures for providing flight operations personnel (pilots and dispatchers) with airplane airworthiness information.

NTSB

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

Non-Compliance

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

NTSB

SMS Components

2. Data collection and analysis

NTSB

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

NTSB

SMS Components

3. Risk Management

NTSB

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

Risk Management

1. Identify Hazards

2. Assess Risk

3. Control (mitigate) Risks

4. Measure Effectiveness of Controls

NTSB

Step 1: Identify Hazards

HAZARDS

- No precision approach

- No operational tower

Flight Safety Foundation
ALAR
Approach-and-landing Accident Reduction
Tool Kit

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?

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 precision approach

- No operational tower

Step 2: Assess Risk

PROBABILITY

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

S E V E R I T Y

Step 3: Control (mitigate) Risk

HAZARDS
- No precision approach
- No operational tower
LEADING TO CFIT

CONTROLS

We will not use this airport:
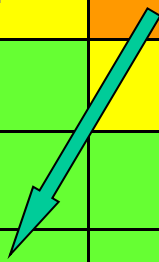
–at night (when control tower is closed)

AND

– when weather is forecast below 800/2.

Determining Residual Risk

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	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

No precision approach

No operational tower

RAC

2 (Unlikely, Catastrophic)

2 (Unlikely, Catastrophic)

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 <u>possible</u>.

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Hierarchy of Controls*

1. Eliminate the hazard through Design
   - Hazard is corrected and eliminated

2. Incorporate 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 "System Safety Order of Precedence"

NTSB

Make Risk Decisions at the Appropriate Level

NTSB

SMS Components

4. Safety Culture

Safety Culture

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

SMS Components

1. Written policies, procedures and guidelines

2. Data collection and analysis

3. Risk management

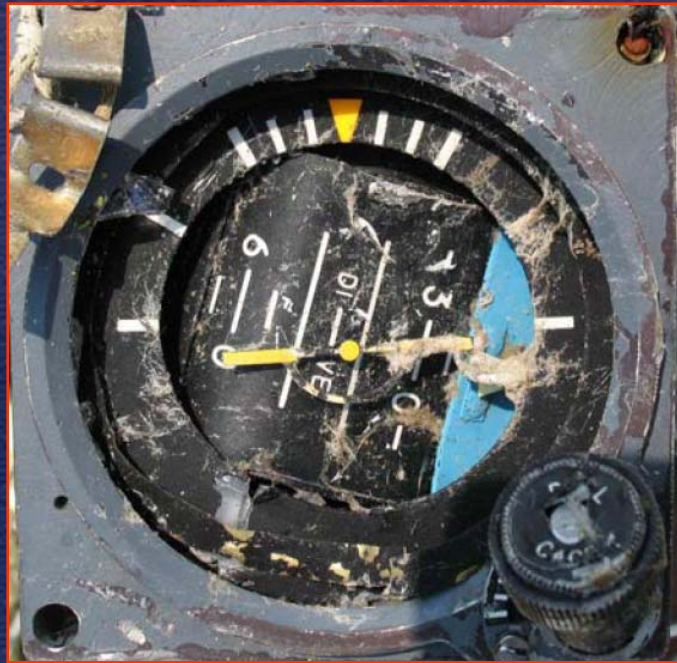4. Safety culture

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A Practical Look at Establishing a Safety Culture

Robert Sumwalt

June 4, 2007

NTSB

NTSB

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.

NTSB

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 <u>inadequate company safety culture</u> that allowed an ill-prepared first officer to fly in Part 135 operations."

NTSB

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 responsibilty for supervision and training of all company pilots, contributed to an <u>inadequate company safety culture</u> that allowed an ill-prepared first officer to fly in Part 135 operations."

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."
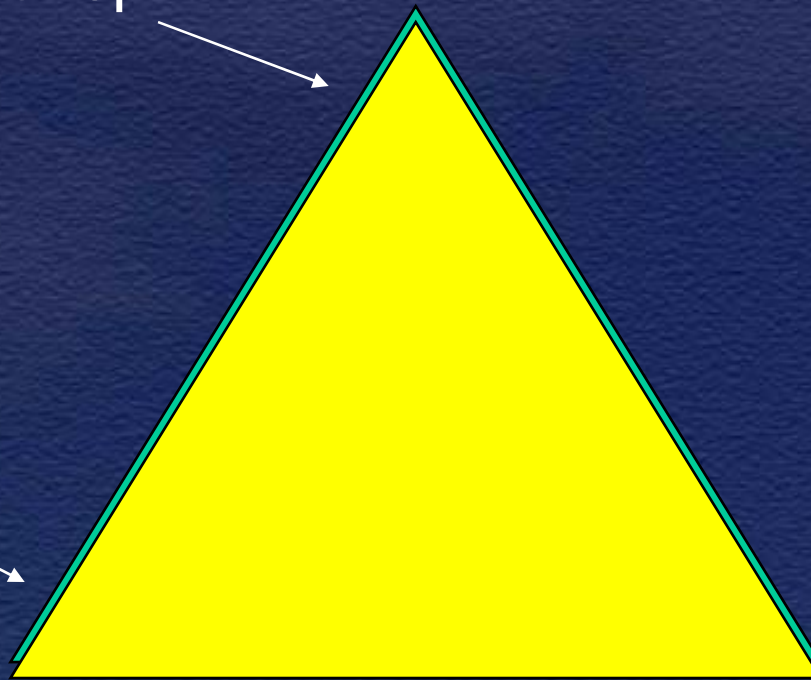
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Safety Culture is:

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.

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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Safety culture

- "Safety culture is a set of established attitudes, values, beliefs, norms, and practices,where safety is revered, promoted treated as an overriding priority.
  – It begins at the top of an organization and permeates throughout the organization."

Source: U.S. Nuclear Regulatory Commission

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Roadmap to Safety Culture
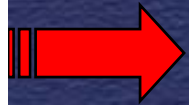
1. Management Commitment and Emphasis
2. Standardization and Discipline
3. Continuous Learning and Risk Awareness

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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

July 10, 2007, Sanford, FL

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

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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

NTSB

Organizational failings

- 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."

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Roadmap to Safety Culture

1. Management Commitment and Emphasis

2. Standardization and Discipline

3. Continuous Learning and Risk Awareness

Lautman-Gallimore Findings: Best Practices

Standardization and discipline

- – Management stresses need for these items

- – Cockpit procedural compliance, callouts, and checklist usage are tightly controlled.

East Coast Jets

Aviation-safety.net © Paul Kanagie / PHLAIRLINE.COM

Owatonna, MN
July 31, 2008
8 fatalities

NTSB

Accident sequence

- Wet runway, 8 knot tailwind
- After touchdown, Captain delayed 7 seconds before deploying Lift Dump
- 17 seconds after touchdown, captain initiated go-around/ takeoff attempt
  - Appx. 1200 feet from runway end
  - Appx. 75 – 80 knots
- Collided with localizer antenna

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Finding related to SOPs

- "If, as a Part 135 operator, East Coast Jets had been required to develop standard operating procedures and its pilots had been required to adhere to them, many of the deficiencies demonstrated by the pilots during the accident flight might have been corrected by the resultant stricter cockpit discipline."

Designates which crewmember performs action or callout

Triggering event

Callout

Action

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

Callouts: in "BOLD TEXT" -- Actions: with bullets (•) in plain text

	PF	PM
Initial Approach	"FLAPS 1 REF 60"	• Select flaps 1 • Set command airspeed cursor to V_{REF} 30 + 60, if requested
	"FLAPS 5, REF 40"	• Select flaps 5 • Set command airspeed cursor to V_{REF} 30 + 40, if requested
2-1/2 miles from FAF	"GEAR DOWN, FLAPS 20, REF 20, LANDING CHECKLIST"	• Position gear lever DOWN • Select flaps 20 • Set command airspeed cursor to VREF 30 + 20, if requested • Initiate Landing Checklist
½ mile prior to FAF	"FLAPS 30, REF 5"	• Select flaps 30 • Set command airspeed cursor to VREF 30 + 5, if requested
	• Set Request MDA or MDA Buffer Altitude	• Set altitude, if requested

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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..."

"... the flight department had started out as just one pilot and one airplane, and that they now had five pilots and two airplanes..."

October 25, 2002

Standardization

- Maneuvers Guide – contained key procedures for briefing and conducting instrument approaches
  - Pilots were expected to adhere to procedures in Maneuvers Guide
  - Maneuvers Guide was only issued to the chief pilot and instructors

Standardization

- Company check airman: rated company's standardization as "6"
- Company pilot: "Fair to good"
- Lead ground instructor: "Fair"
  - Suspected that some pilots were following SOPs while others were not
  - Aware that some pilots used their own checklists, instead of company checklists
- Another pilot: never seen any standardized callouts documented in any company manual
  - To compensate, she used callouts she used at another company

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Roadmap to Safety Culture

1. Management Commitment and Emphasis

2. Standardization and Discipline

3. Continuous Learning and Risk Awareness

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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.

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."

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Using the right metrics

- Are you measuring the right things?

- Are they the most appropriate predictors of catastrophic events?

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Pinnacle Airlines

- Jefferson City, MO
- October 14, 2004
- Bombardier Regional Jet
- Repositioning flight
- Both flight crewmembers killed

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What the investigation discovered

- Intentional activation of stall warning
- Swapping crew seats
- Rudder mishandling
- Climb to FL 410
  - "have a little fun"
- Automation mismanagement
- Airspeed loss, stall, loss of control, double engine failure
- Did not maintain proper speed for engine failure
- Did not fully disclose real problem with ATC

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Why was the crew at 41,000?

Did the airline …

- Did the airline know about "410 Club?"

- How did airline monitor adherence to SOPs?

- Did they have a FOQA program?

- Did they have an ASAP program?

- Did they have a Safety hotline?

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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?

NTSB

Employees

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

NTSB

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

NTSB

Reporting culture is essential

- "There is growing realization in the aviation industry that encouraging prompt reporting of safety issues actually reduces the number of accidents and incidents.

- "An environment of 'open reporting' is a key element in fostering a 'just culture' for the systematic reporting, collection, analysis and dissemination of safety information that will be used solely to prevent accidents."

  – Flight Safety Foundation "Ramp Safety Operational Procedures – A template for ramp supervisors"

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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.

Roadmap to Safety Culture

1. Management Commitment and Emphasis

2. Standardization and Discipline

3. Continuous Learning and Risk Awareness

Do you have a good safety culture?

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Roadmap to Safety Culture

1. Management Commitment and Emphasis

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