



NTSB National Transportation Safety Board

SMS: What the heck is it, anyway?

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Operations Team Leadership Workshop
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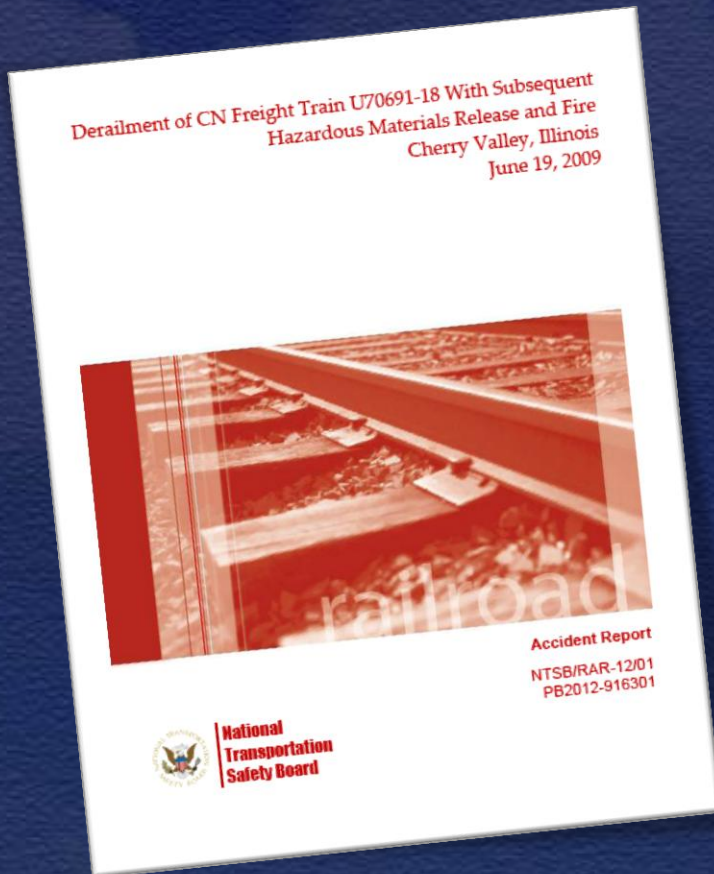
Robert L. Sumwalt

CN derailment

- HazMat release
- Fire
- 1 Fatality
- Cherry Valley
- June 2009



NTSB Finding



- “Had an effective safety management system been implemented at the CN, the inadequacies and risks that led to the accident would have been identified and corrected and, as a result, the accident may have been prevented.”

NTSB Recommendation to FRA

- “Require that safety management systems and the associated key principles (including top-down ownership and policies, analysis of operational incidents and accidents, hazard identification and risk management, prevention and mitigation programs, and continuous evaluation and improvement programs) be incorporated into railroads’ risk reduction programs ...”
 - (NTSB Recommendation R-12-3)

What is a Safety Management System?

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

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

- From NTSB report of CN derailment, page 83

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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 Principles (GAAP); financial procedures, controls, audits, accountability

What's in a name?

- Safety Management Systems
 - “Something you have”

- Safety Management
 - “Something you do”

- From Don Arendt, Ph.D., FAA

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



SMS Components

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

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.

CN accident

- CN's inadequate weather policies and rules provided insufficient and vague guidance
 - in not requiring rail traffic controllers to read weather alerts verbatim to train crews
 - did not clearly specify whether train crews should operate trains at a restricted speed after receiving an alert
 - provided no notification requirement that track inspectors conduct severe weather related inspections prior to train operations
 - and did not consolidate weather alert notices and the appropriate operation of trains into a single rule.
- The rail traffic controller did not follow CN weather procedures of alerting the train crew for potential for heavy rains and flash flooding along their route.

Washington DC Subway (WMATA)



Probable Cause

- Failure of the track circuit modules
- WMATA's failure to ensure that an enhanced track circuit verification test was institutionalized and used system-wide after a 2005 precursor event (near-collisions)



SMS Components

2. Data collection and analysis

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

SMS Components

3. Risk Management

Why Risk Management?

- “A thorough work risk assessment of dispatching operations may have identified several deficiencies that, if corrected, would have ensured safety-critical tasks were addressed appropriately.”

– From NTSB report of CN derailment



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

Risk Management

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

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

Risk Management

1. Identify Hazards

 2. Assess Risk

3. Control (mitigate) Risks

4. Measure Effectiveness of Controls

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

**S
E
V
E
R
I
T
Y**

	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 Probability

Likely - Occurs several times.

Occasional - Occurs sporadically

Seldom - May occur at some time

Unlikely - Can assume it will not occur

MIL-STD-882E: Example of Mishap Probabilities

PROBABILITY LEVELS			
Description	Level	Specific Individual Item	Fleet or Inventory
Frequent	A	Likely to occur often in the life of an item.	Continuously experienced.
Probable	B	Will occur several times in the life of an item.	Will occur frequently.
Occasional	C	Likely to occur sometime in the life of an item.	Will occur several times.
Remote	D	Unlikely, but possible to occur in the life of an item.	Unlikely, but can reasonably be expected to occur.
Improbable	E	So unlikely, it can be assumed occurrence may not be experienced in the life of an item.	Unlikely to occur, but possible.
Eliminated	F	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.

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-882E:

Example of Mishap Severities

SEVERITY CATEGORIES

Description	Severity Category	Mishap Result Criteria
Catastrophic	1	Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or monetary loss equal to or exceeding \$10M.
Critical	2	Could result in one or more of the following: permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, reversible significant environmental impact, or monetary loss equal to or exceeding \$1M but less than \$10M.
Marginal	3	Could result in one or more of the following: injury or occupational illness resulting in one or more lost work day(s), reversible moderate environmental impact, or monetary loss equal to or exceeding \$100K but less than \$1M.
Negligible	4	Could result in one or more of the following: injury or occupational illness not resulting in a lost work day, minimal environmental impact, or monetary loss less than \$100K.

Step 2: Assess Risk

PROBABILITY

	Unlikely	Seldom	Occasional	Likely
S E V E R I T Y				
Catastrophic	5	3	4	4
Critical	1	2	3	4
Marginal	1	1	2	3
Negligible	1	1	2	2

Risk Management

1. Identify Hazards

2. Assess Risk

 3. Control (mitigate) Risks

4. Measure Effectiveness of Controls

Ways we can deal with risk

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

Determining Residual Risk

PROBABILITY

	Unlikely	Seldom	Occasional	Likely
S E V E R I T Y				
Catastrophic	2	3	4	4
Critical	1	2	3	4
Marginal	1	1	2	3
Negligible	1	1	2	2

Risk Management

1. Identify Hazards

2. Assess Risk

3. Control (mitigate) Risks

 4. Measure Effectiveness of Controls

Measure effectiveness of controls

- Continually reassess to ensure that what you are doing is actually working.
- Seek continuous improvement.

How Much to Risk Reduce?

- ALARP = As Low As Reasonably Practicable
- Different than as low as possible.

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)

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"

Controls to mitigate risks associated with grade crossings



1. Eliminate the hazard through **Design**



2. Incorporate **Guards/ Safety Devices**



3. Provide **Warning Devices**



4. Develop **Procedures and Training**



Make Risk Decisions at the Appropriate Level



SMS Components

4. Safety Culture

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

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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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.”



Safety Culture



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

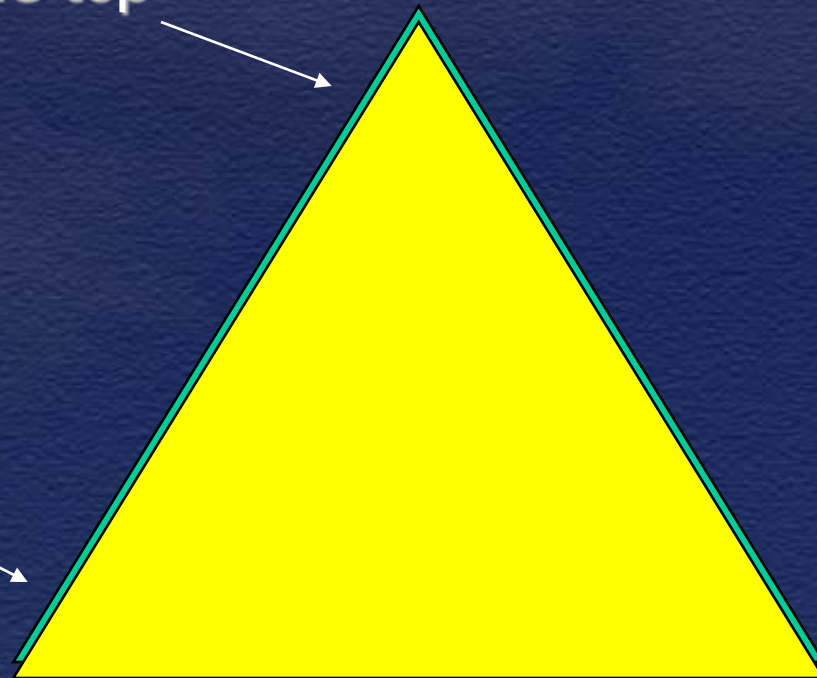
From NTSB report of WMATA Accident

- “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)

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.

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

SMS Components

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

Finally...

- The **lifblood** of SMS is data – having data about 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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