



NTSB National Transportation Safety Board

Collaboration

to

Reduce Risk

and

Improve Productivity

Presentation to: Public Service
Electric & Gas Co.

Name: Christopher A. Hart

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Outline

- **Collaboration to**
 - Reduce risk
 - Investigate mishaps
- **Improving Productivity**
- **Role of**
 - Leaders
 - Regulators



The Context: Increasing Complexity

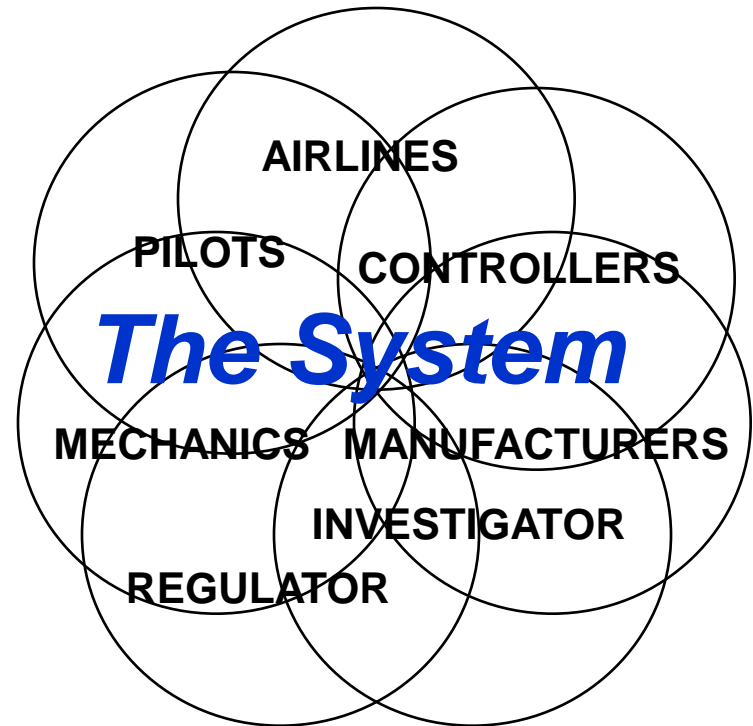
- **More System**

 - *Interdependencies*

 - Large, complex, interactive system
 - Often tightly coupled
 - Hi-tech components
 - Continuous innovation
 - Ongoing evolution

- **Safety Issues Are More Likely to Involve**

 - *Interactions Between Parts of the System*



Effects of Increasing Complexity:

More “Human Error” Because

- **System More Likely to be Error Prone**
- **Operators More Likely to Encounter Unanticipated Situations**
- **Operators More Likely to Encounter Situations in Which “By the Book” May Not Be Optimal (“workarounds”)**



The Solution – System Think

An awareness of how a change in one subsystem of a complex system may affect other subsystems within that system

“System Think” via Collaboration

Bringing all parts of a complex system together to

- Identify potential issues
- *PRIORITIZE* the issues
- Develop solutions for the prioritized issues
- Evaluate whether the solutions are
 - Accomplishing the desired result, and
 - Not creating unintended consequences



What Constitutes a “System?”

- **“System” can be defined at any level, including**
 - Entire industry
 - Company (some or all)
 - Type of activity
 - Facility
 - Team



Collaboration: A Major Paradigm Shift

- Old: “Leader” identifies a problem and proposes solutions**
 - Prospective implementers are skeptical of leader’s understanding of the problem
 - Prospective implementers resist leader’s solutions and/or implement them begrudgingly

- New: Collaborative “System Think”**
 - Implementers involved in identifying problem
 - Implementers have “ownership interest” re solution because everyone had input, everyone’s interests mutually considered
 - Prompt and willing implementation (and tweaking)
 - Solution probably more effective and efficient
 - Unintended consequences much less likely

Challenges of Collaboration

- Human nature: “I’m doing great . . . *the problem is everyone else*”
- Differing and sometimes competing interests
 - Labor-management issues between participants
 - Participants are potential adversaries
- “Leader” (regulator?) probably not welcome
- Not a democracy
 - Leader must lead (regulator must regulate)
- Requires all to be willing, in their enlightened self-interest, to leave their “comfort zone” and think of the System

Collaboration Can Be Used To:

- ***Reduce risk***
(to prevent mishaps)

and

- ***Analyze mishaps***
(to determine what to fix)

Collaboration to Reduce Risk

Is the **Person**
Clumsy?

Or Is the
Problem . . .

The *Step???*



Enhance Understanding of Person/System Interactions By:

- **Collecting,**
- **Analyzing, and**
- **Sharing**

Information



Objectives:

Make the System

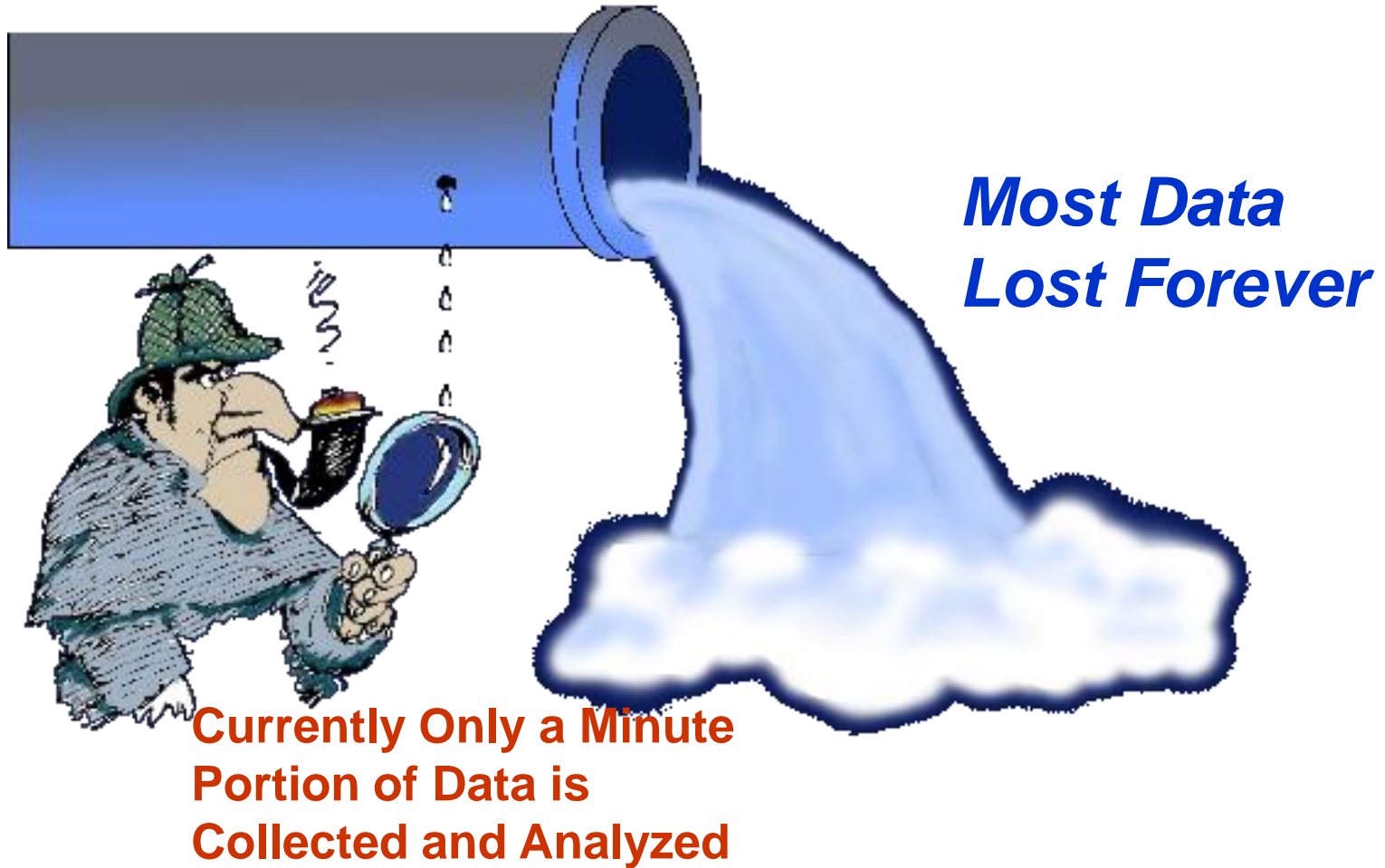
*(a) Less
Error Prone*

and

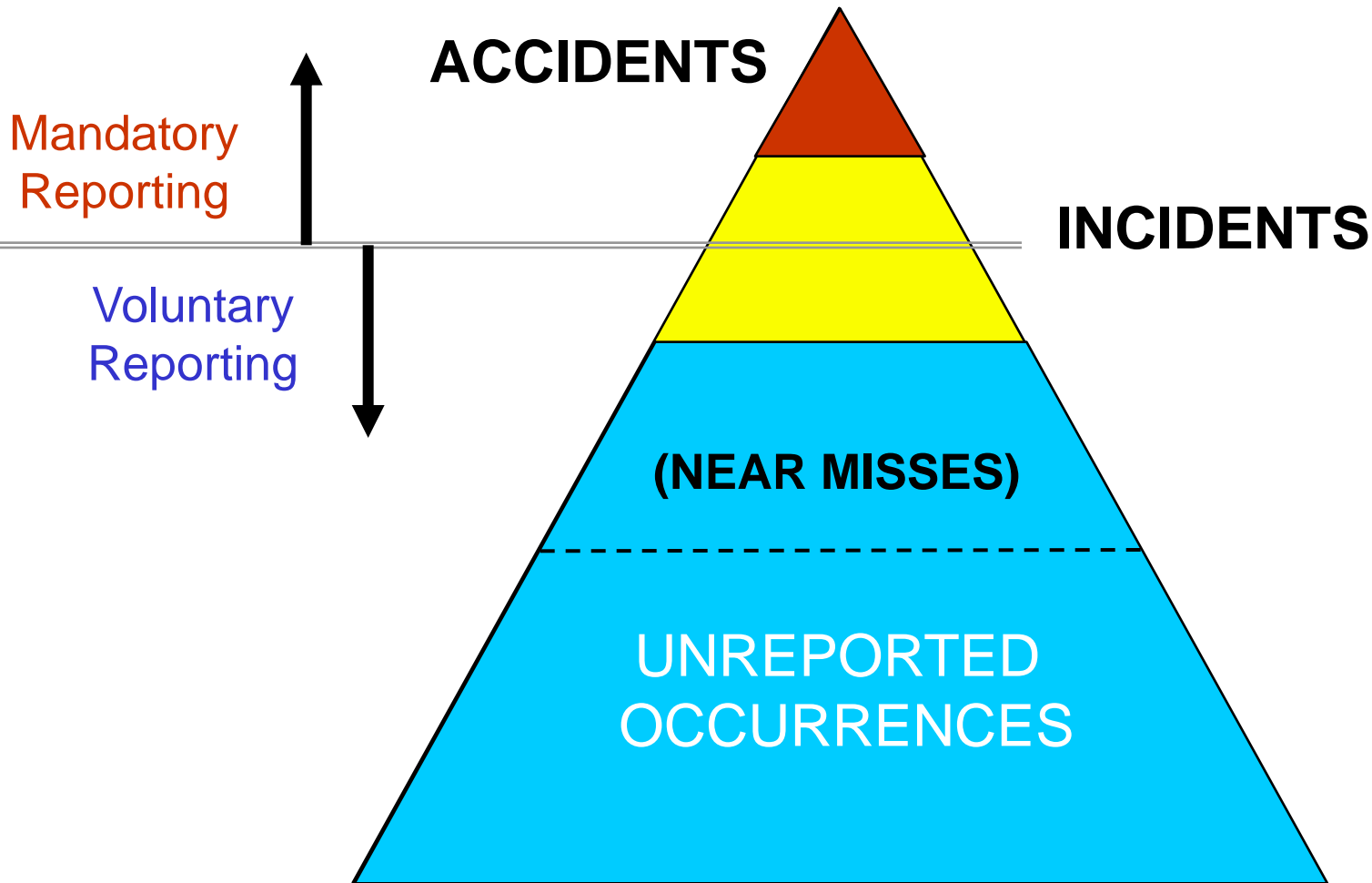
*(b) More
Error Tolerant*



Current System Data Flow



Heinrich Pyramid



Major Source of Information: Hands-On “Front-Line” Employees

“We Knew About That Problem”

***(and we knew it might hurt
someone sooner or later)***

Legal Concerns That Discourage Collection, Analysis, and Sharing

- **Public Disclosure**
- **Job Sanctions and/or Enforcement**
- **Criminal Sanctions**
- **Civil Litigation**



Typical “Cultural” Barrier



CEO

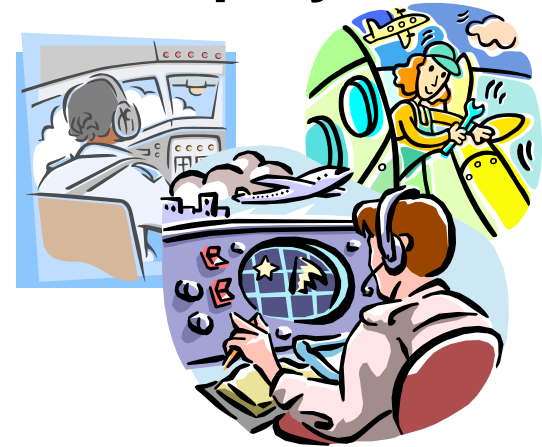
“Safety First”

**Middle
Management**



“Production First”

**Front-Line
Employees**



**“Please the Boss First...
THEN Consider Safety?”**

Next Challenge



Legal/Cultural Issues

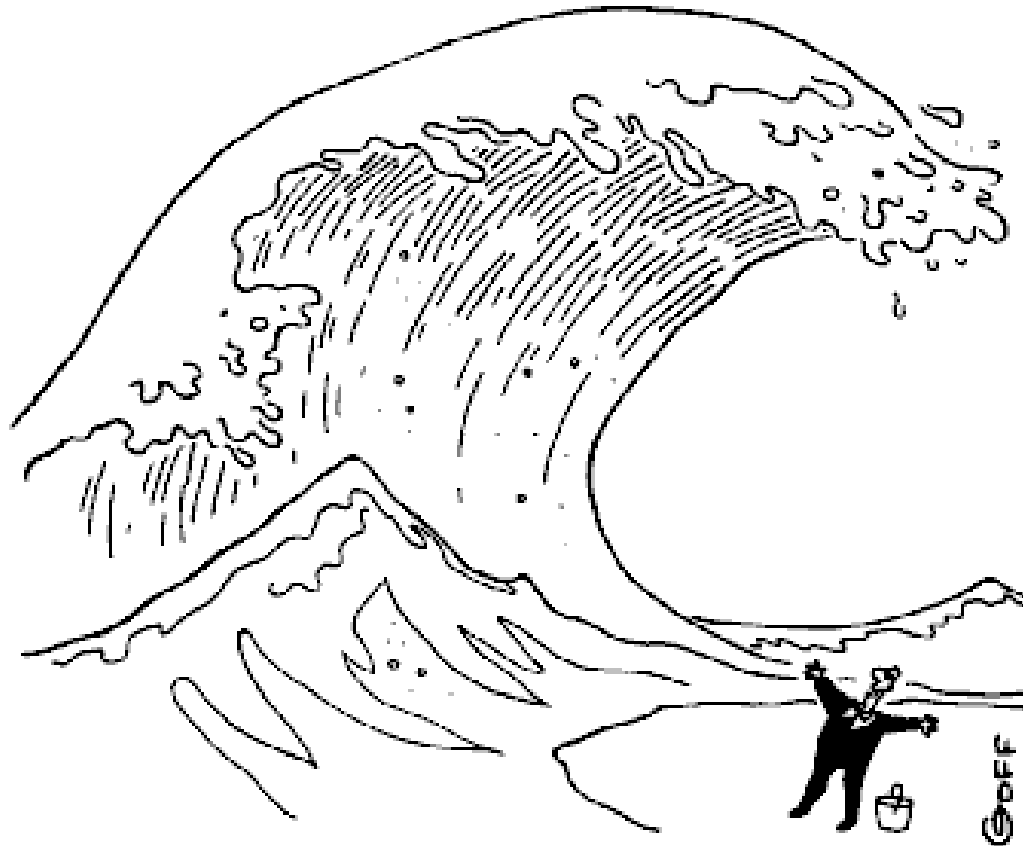
Improved Analytical Tools

As we begin to get over the first hurdle, we must start working on the next one . . .



Information Overload

© 1996 Ted Goff



"EUREKA! MORE INFORMATION!"

From Data to Information

Tools and processes to convert large quantities of data into useful information

Data Sources

Info from front line staff and other sources

DATA



Analysts

USEFUL

INFORMATION

Smart Decisions

- Identify issues
- **PRIORITIZE!!!**
- Develop solutions
- Evaluate interventions

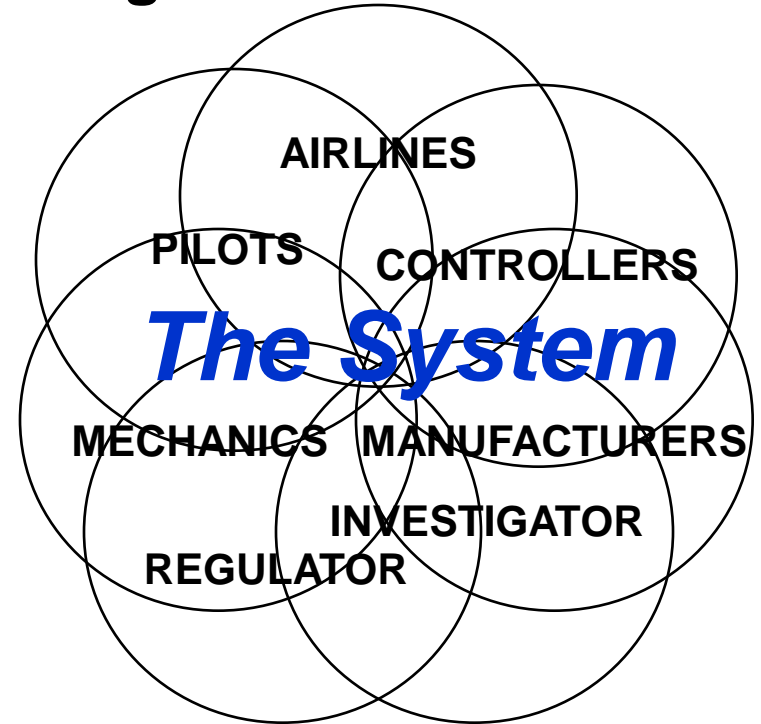
Tools



Processes

Aviation “System Think” Success

- Engage All Participants In Identifying Problems and Developing and Evaluating Remedies
- Airlines
- Manufacturers
 - *With the systemwide effort*
 - *With their own end users*
- Air Traffic Organizations
- Labor
 - *Pilots*
 - *Mechanics*
 - *Air traffic controllers*
- Regulator(s) [Query: Investigator(s)?]



Aviation Success Story

65% Decrease in Fatal Accident Rate,

1997 - 2007

largely because of

System Think

fueled by

***Proactive Safety Information
Programs***

P.S. Aviation was already considered **VERY SAFE** in 1997!!

Footnote

**This collaborative process was
successful**

without generating

any new regulations!!

Manufacturer “System Think” Success

Aircraft manufacturers are increasingly seeking input, throughout the design process, from

- *Pilots* (User Friendly)
- *Mechanics* (Maintenance Friendly)
- *Air Traffic Services* (System Friendly)

Failure: Could Better Information Have Broken the Chain?

- **Strasbourg, France, 1992**
- **Risk Factors**
 - *Night, Mountainous Terrain*
 - *No Ground Radar*
 - *No Ground-Based Glideslope Guidance*
 - *No Airborne Terrain Alerting Equipment*
- **Very Sophisticated Autopilot**
- **Autopilot Mode Ambiguity**



Autopilot Mode Ambiguity

- “3.2” in the window, *with a decimal*, means:
 - Descend at a 3.2 degree angle (about 700 fpm at 140 knots)
- “32” in the window, *without a decimal*, means:
 - Descend at 3200 fpm
- **Clue: Quick Changes in Autopilot Mode Frequently Signal a Problem**
 - *Flight data recorder readout program could have helped safety experts uncover this problem*

Another Failure: Inadequate “System Think”

- 1995 – Cali, Colombia
- Risk Factors
 - *Night*
 - *Airport in Deep Valley*
 - *No Ground Radar*
 - *Airborne Terrain Alerting Limited to “Look-Down”*
 - *Last Minute Change in Approach*
 - *More rapid descent (throttles idle, spoilers)*
 - *Hurried reprogramming*
- Navigation Radio Ambiguity
- Spoilers Do Not Retract With Power



Recommended Remedies Include:

- **Operational**
 - *Caution Re Last Minute Changes to the Approach*
- **Aircraft/Avionics**
 - Enhanced Ground Proximity Warning System
 - Spoilers That Retract With Max Power
 - Require Confirmation of Non-Obvious Changes
 - Unused or Passed Waypoints Remain In View
- **Infrastructure**
 - Three-Letter Navigational Radio Identifiers
 - Ground-Based Radar
 - Improved Reporting of, and Acting Upon, Safety Issues

Note: All but one of these eight remedies address system issues

Collaboration if (*when*)

prevention fails

and a mishap occurs . . .

When Something Goes Wrong

How It Is Now . . .

You are highly trained

and

If you did as trained, you
would not make mistakes

so

You weren't careful
enough

so

You should be **PUNISHED!**

How It Should Be . . .

You are human

and

Humans make mistakes

so

Let's *also* explore why the
system allowed, or failed to
accommodate, your mistake

and

Let's **IMPROVE THE SYSTEM!**

Another Industry

To Err Is Human:

Building a Safer Health System

“The focus must shift from blaming individuals for past errors to a focus on preventing future errors by designing safety into the system.”

Institute of Medicine, Committee on Quality of Health Care in America, 1999

Collaboration After Mishaps

- Collaboration is more difficult after a mishap because potential “cause agents” are more defensive
- Investigator should be *unbiased and impartial* (i.e., *not* one of the potential cause agents)
- The NTSB investigates to determine probable cause(s) and make recommendations to prevent recurrences
- NTSB relies extensively upon parties to help develop the facts
- NTSB selects parties for their ability to provide *technical* expertise
 - No attorneys/insurers
 - No plaintiffs/representatives



NTSB's Analysis

- **Impartial and unbiased because NTSB is not a regulator or an operator, has “no dog in the fight”**
- **Also impartial because parties do not assist with analysis, done solely by NTSB**
 - **Impartiality more important than collaboration for the analysis**
- **Not admissible in court**



Result of NTSB's Investigation

- Determination of probable cause(s)
- Objective is to determine *cause(s)*,
not liability or blame
- ***SINGLE FOCUS IS SAFETY***
- Primary NTSB product: Safety recommendations to whomever can take appropriate corrective action
- Recommendation acceptance rate > 80%

**How Can
Collaboration
Help Improve
Productivity???**

Not Only Improved Safety, But Improved Productivity, Too

- **Ground Proximity Warning System**
 - **S: *Reduced warning system complacency***
 - **P: *Reduced unnecessary missed approaches, saved workload, time, and fuel***
- **Flap Overspeed**
 - **S: *No more potentially compromised airplanes***
 - **P: *Significantly reduced need to take airplanes off line for **VERY EXPENSIVE (!!) disassembly, inspection, repair, and reassembly*****

But Then . . .

Why Are We

So Jaded in The Belief That

Improving Safety

Will Probably

Hurt The Bottom Line??

Costly Result\$ Of Safety Improvements Poorly Done

Safety *Poorly* Done

- 1. Punish/re-train operator**
 - Poor workforce morale*
 - Poor labor-management relations*
 - Labor reluctant to tell management what's wrong*
 - Retraining/learning curve of new employee if "perpetrator" moved/fired*
 - Adverse impacts of equipment design ignored, problem may recur because manufacturers are not involved in improvement process*
 - Adverse impacts of procedures ignored, problem may recur because procedure originators (management and/or regulator) are not involved in improvement process*

Safety *Well* Done

**Look beyond operator,
also consider system
issues**

Costly Result\$ Of Safety Poorly Done (con't)

Safety *Poorly* Done

2. Management decides remedies unilaterally

- *Problem may not be fixed*
- *Remedy may not be most effective, may generate other problems*
- *Remedy may not be most cost effective, may reduce productivity*
- *Reluctance to develop/implement remedies due to past remedy failures*
- *Remedies less likely to address multiple problems*

3. Remedies based upon instinct, gut feeling

- *Same costly results as No. 2, above*

Safety *Well* Done

Apply “System Think,” *with workers*, to identify and solve problems

Remedies based upon evidence (including info from front-line workers)

Costly Result\$ Of Safety Poorly Done (con't)

Safety *Poorly* Done

4. Implementation is
last step

- *No measure of how well remedy worked (until next mishap)*
- *No measure of unintended consequences (until something else goes wrong)*

Safety *Well* Done

Evaluation after
implementation

So . . . Is Safety Good Business?

- *Safety implemented poorly can be **very costly (and ineffective)***
- *Safety implemented well, in addition to improving safety more effectively, can also **create benefits greater than the costs***

Information Pipeline: A Valuable Tool

**FRONTLINE
WORKERS**

Information About Safety
And Productivity,
Efficiency,
Quality,
and Other Production Metrics

YE
WHO
CAN
FIX

Significant Opportunity

Bottom-Line Benefits From a
Well-Implemented Safety Information Program
Can Change the Dynamic From

**“Another Safety Program
I Can’t Afford”**

To

\$\$\$ A Profit Center \$\$\$

Other Potential Benefits:

- **Better Labor Relations**
 - Transforms workforce from brunt of blame when things go wrong, to valuable source of information about potential problems and how to remedy them, *i.e.*, converts labor and management from **Adversaries** to **Partners in Improvement**
- **Reduced Legal Exposure**
 - Collecting, analyzing, and sharing will become industry standard for most, if not all, potentially hazardous endeavors; **woe to those who don't**



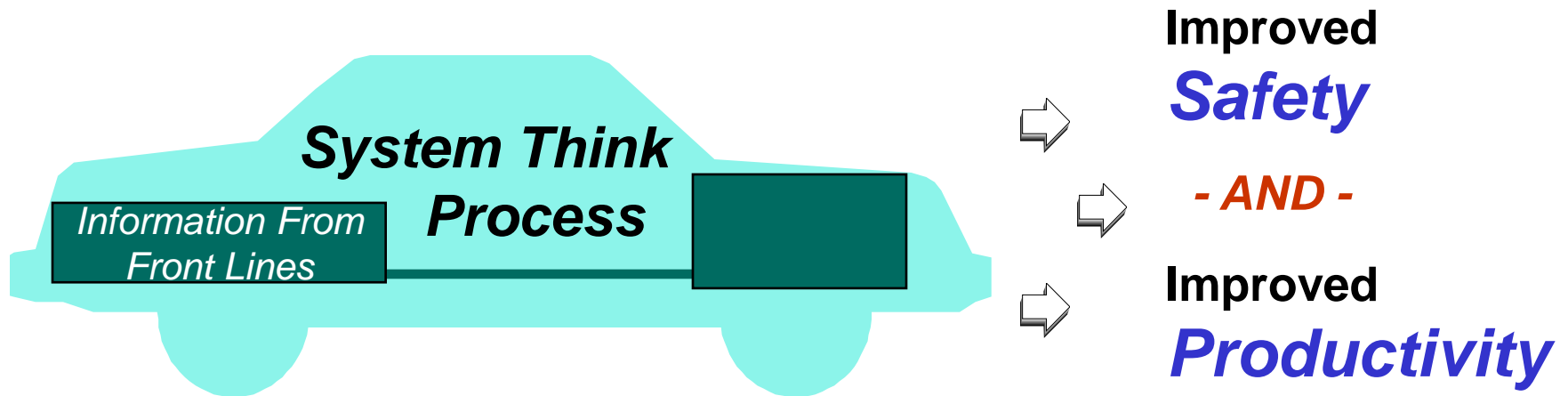
The Role of Leadership

- Demonstrate Safety Commitment . . .
But Acknowledge That Mistakes Will Happen
- Include “Us” (e.g., System) Issues,
Not Just “You” (e.g., Training) Issues
- **Make Safety a Middle Management Metric**
- Engage Labor Early
- Include the *System* --
Manufacturers, Operators, Regulator(s), and Others
- Encourage and Facilitate Reporting
- Provide *Feedback*
- Provide Adequate *Resources*
- *Follow Through* With Action

How The Regulator Can Help

- Emphasize importance of System issues *in addition to* (not instead of) worker issues
- Encourage and participate in industry-wide “System Think”
- Facilitate collection and analysis of information
 - Clarify and announce *policies for protecting information and those who provide it*
 - Encourage other industry participants to do the same
- Recognize that *compliance* is very important, but the *mission is reducing systemic risk*

Conclusion: Process Plus Fuel Enables A Win-Win



Thank You!!!



Questions?