NTSB National Transportation Safety Board

Reducing Risk While Improving Productivity:

Key Lessons Learned

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BBS/HPI Best Practices Workshop

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The Contrast

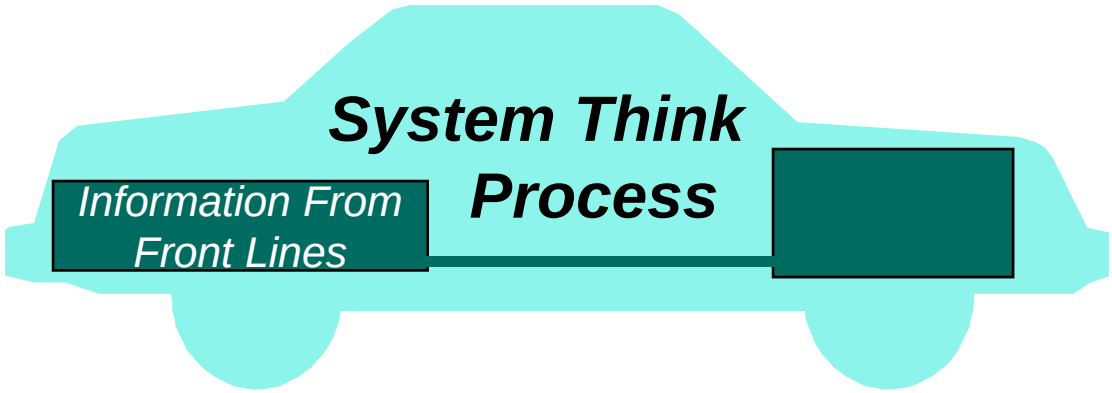
- Conventional Wisdom:

Improvements that reduce risk usually *also reduce productivity*

- Lesson Learned from Proactive Aviation Safety Information Programs:

Risk can be reduced in a way that also results in *immediate productivity improvements*

Process Plus Fuel Creates A Win-Win



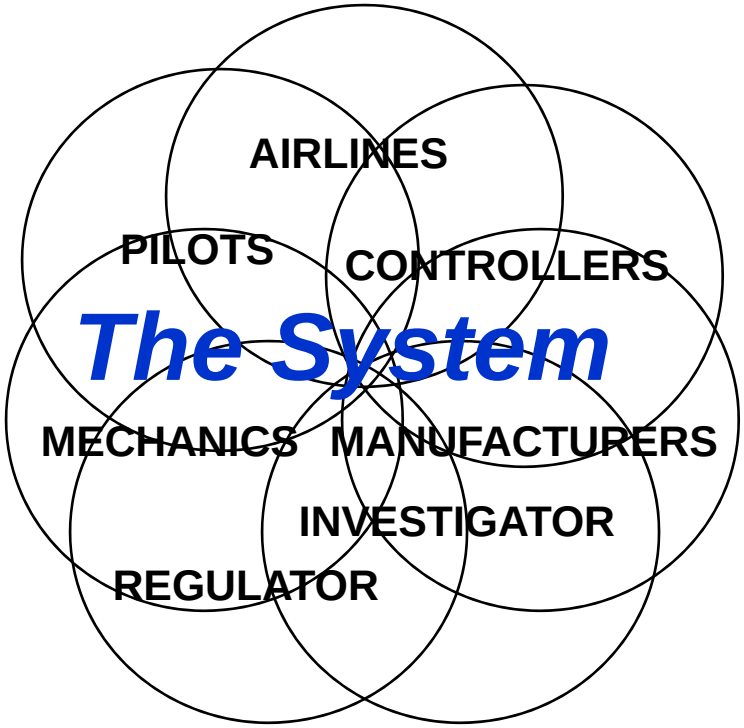
Improved
Safety
- AND -
Improved
Productivity

Outline

- The Context
- Importance of Better Information
- Importance of “System Think”
- Safety Benefits
- Productivity Benefits
- Aviation Successes and Failures
- The Role of Leadership

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 Result:

Front-Line Staff Who Are

- Highly Trained

- Competent

- Experienced,

-Trying to Do the Right Thing, and

- Proud of Doing It Well

. . . Yet They Still Commit

Inadvertent

Human Errors

When Things Go 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!

Fix the Person or the System?

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

The Health Care 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

Creating a "Just Culture"

Objective is not to *DECREASE*

the safety accountability

of the *OPERATOR* . . .*

but to . . .

***INCREASE* the safety accountability**

of everyone who designs, builds, manages, maintains, and regulates

the *SYSTEM*

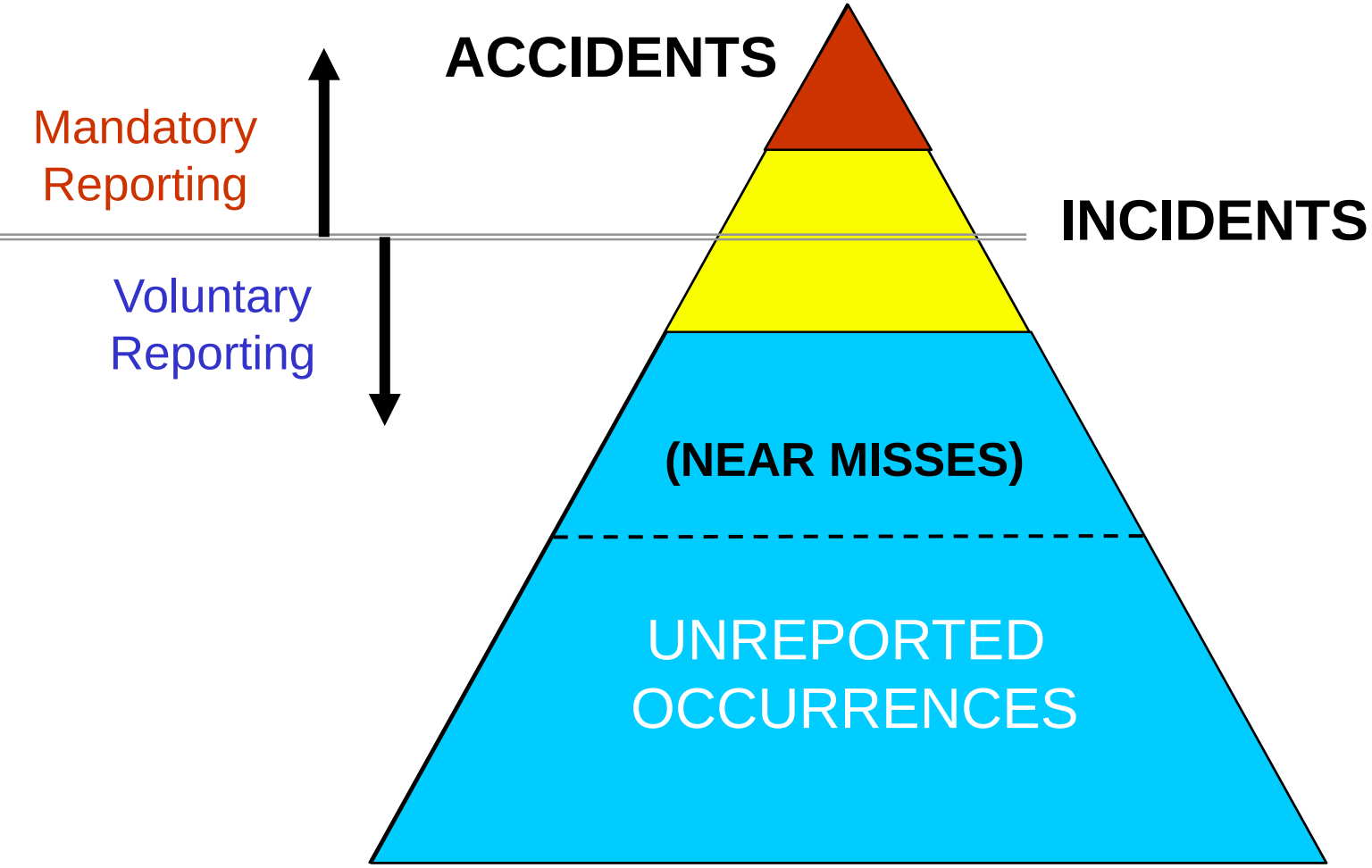
i.e., NOT "Non-Punitive" or "Get Out of Jail Free"

Current System Data Flow

Most Data Lost Forever

Currently Only a Minute Portion of Data is Collected and Analyzed

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

"Safety First"

Middle Management

"Production First"

Front-Line Employees

"Please the Boss First…
THEN Consider Safety?"

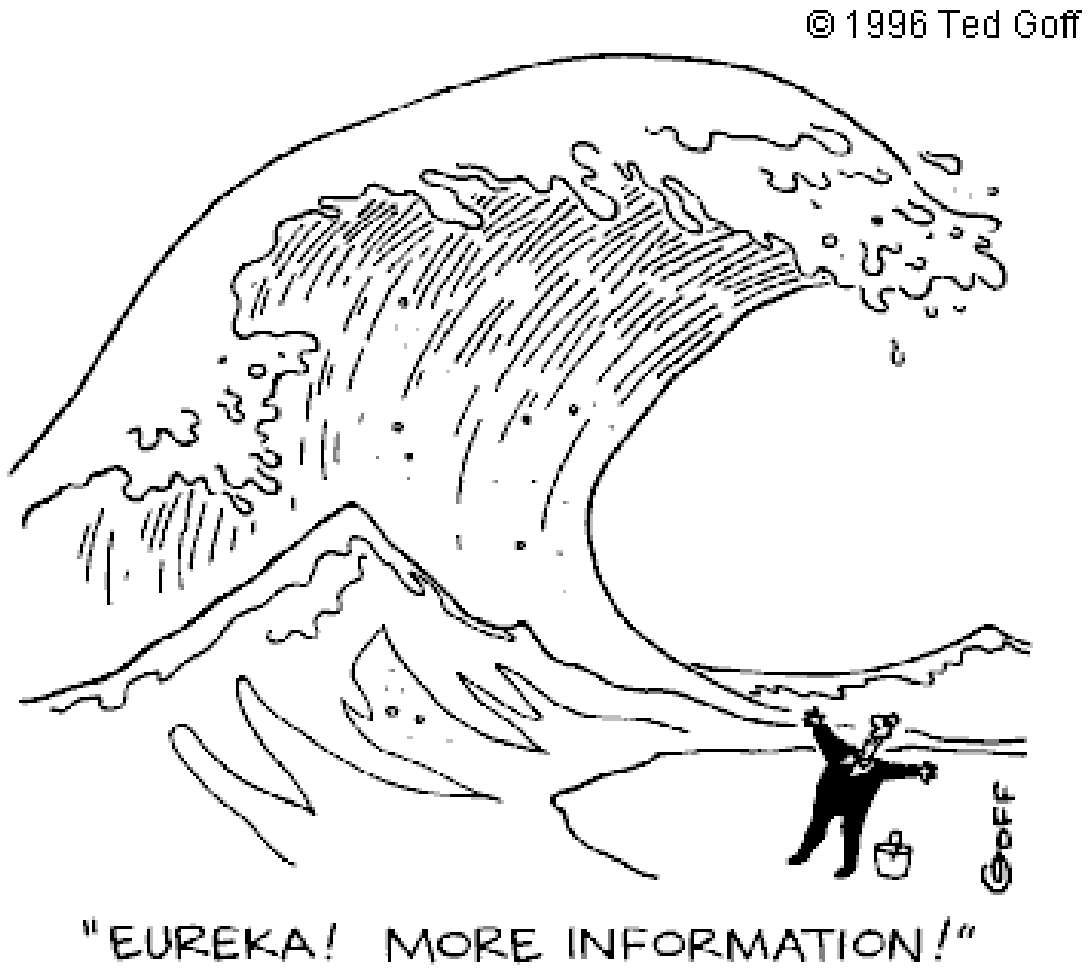
Next Challenge

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



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

Tools

Processes

USEFUL

INFORMATION

Smart Decisions

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

Analytical Challenges

Analytical Tools Must Support Development of --

- **Interventions that address *SYSTEM* issues, not just *OPERATOR* issues, and**
- **System interventions that**
  - **Are *SYSTEM-WIDE* in scope, and**
  - **Focus more extensively on *HUMAN FACTORS***

Prioritization: The Most Difficult Step

How Many *Other Pressing Issues* (If Any) Were Being Addressed When:

- **NASA responded inadequately to previous events of separated foam that struck the orbiter during launch**
- **Concorde manufacturer and operators responded inadequately to previous tire disintegrations during takeoff**
- **Ford and Firestone responded inadequately to previous tire failures and rollovers in Ford Explorers**
- **The intelligence community responded inadequately to reports about people who wanted to learn to fly – but not how to land – in an airliner flight simulator**

Missing Element – The Harsh Glare of Hindsight

Aviation Success Story

65% Decrease **in Fatal Accident Rate, 1997 - 2007**

largely because of

Proactive

Safety Information Programs

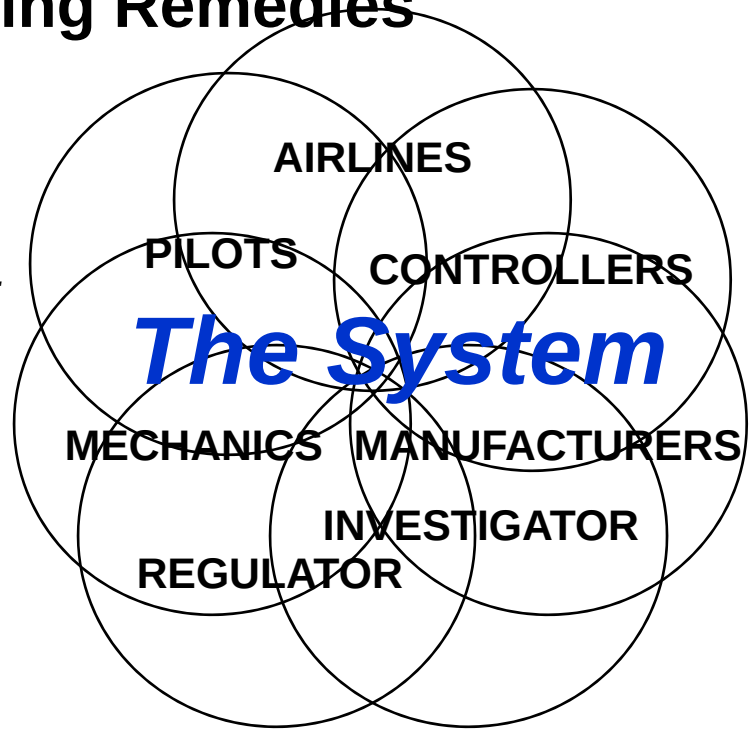
plus

System Think

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

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)?]**



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: Inadequate Information

- **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***

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**

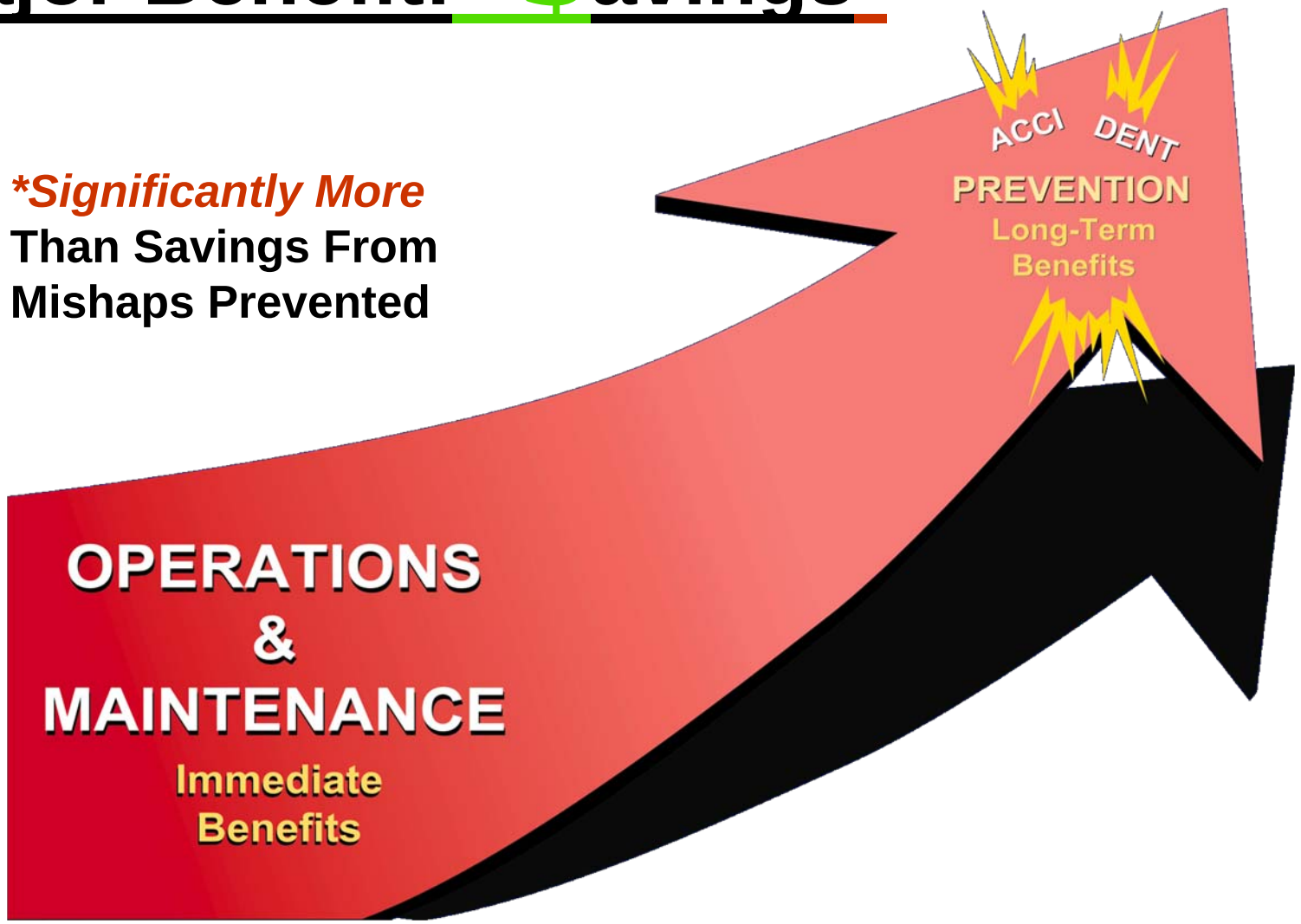
Recommended Remedies Include:

- **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

Major Benefit: $avings*

**Significantly More*
Than Savings From Mishaps Prevented



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	Safety *Well* Done
1. Punish/re-train operator	**Look beyond operator, also consider system issues**

- 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

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

Safety *Poorly* Done	Safety *Well* Done
2. Management decides remedies unilaterally	**Apply "System Think," *with workers*, to identify and solve problems**
- 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	**Remedies based upon evidence (including info from front-line workers)**
- Same costly results as No. 2, above	

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

Safety *Poorly* Done	Safety *Well* Done
4. Implementation is last step	**Evaluation after implementation**

- No measure of how well remedy worked (until next mishap)

- No measure of unintended consequences (until something else goes wrong)

Conclusion: 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

Significant Opportunity

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

"Another Safety Program
I Can't Afford"

To

$$$ A Profit Center $$$

Safety Plus Productivity Successes

- **Ground Proximity Warning Example**
  - ***S: Reduced warning system complacency***
  - ***P: Reduced unnecessary missed approaches, saved time and fuel***
- **Flap Overspeed**
  - ***S: Removed compromised airplanes***
  - ***P: Reduced need to take airplane off line for extensive disassembly, inspection, and reassembly***

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

Thank You!!!

Questions?