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How to Employ Risk Management

2004 Annual Workshop on
Risk Analysis & Safety Measurements

Gary Eiff, Ph.D.
Purdue University

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Risk Management Fundamentals

The elements of managing risk include:

1. Identify risks & error potentials
2. Carefully analyze the source of risk
3. Develop methods for mitigating risk
4. Implement mitigation strategy
5. Continually assess the effectiveness of risk reduction strategies

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A Change in Approach

Field studies indicate the need to move from:

Safety *Programs*
to
a Systems Approach to Safety

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A Change in Perspective

Away from a ***Summative*** view of solutions to one embracing a more ***Formative*** approach

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General Systems Theory…

suggests the need to move from:

- Complex & redundant to simple & lean
- Siloed to integrated metrics and solutions
- Localized to organizational focus

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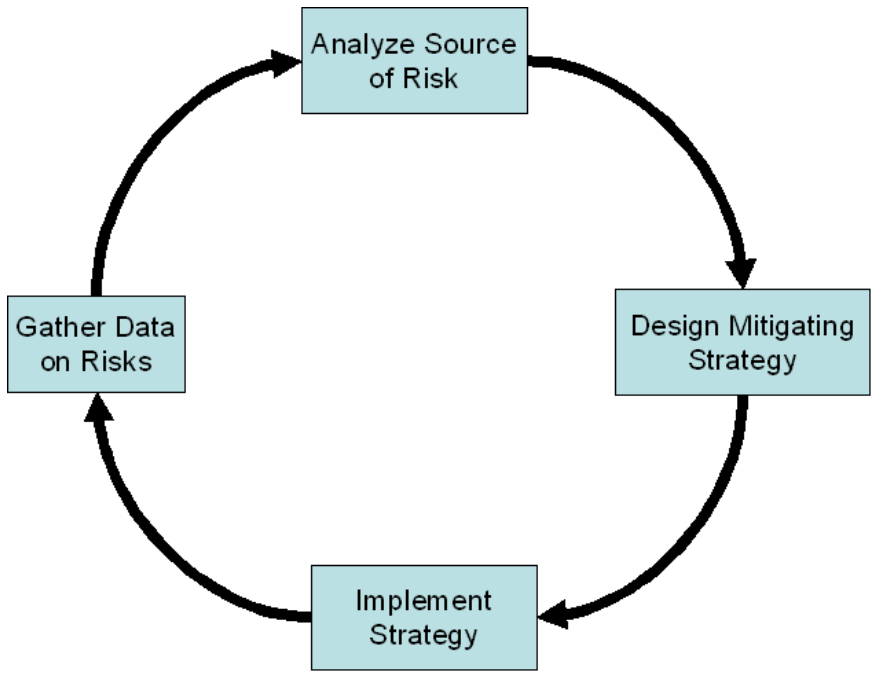
A **Systems** Approach to

Continual Safety Improvement



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Like Any Other Organizational System

…safety systems must be:

- Strategically planned for
- Properly supported with an infrastructure
- Adequately resourced
- Supported & promoted consistently & ***at all levels*** of the organization

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Room for Improvement

Industry's Safety Trend

Recent Purdue University study of 20 years of NTSB airline accident and incident data to determine Industry safety trends

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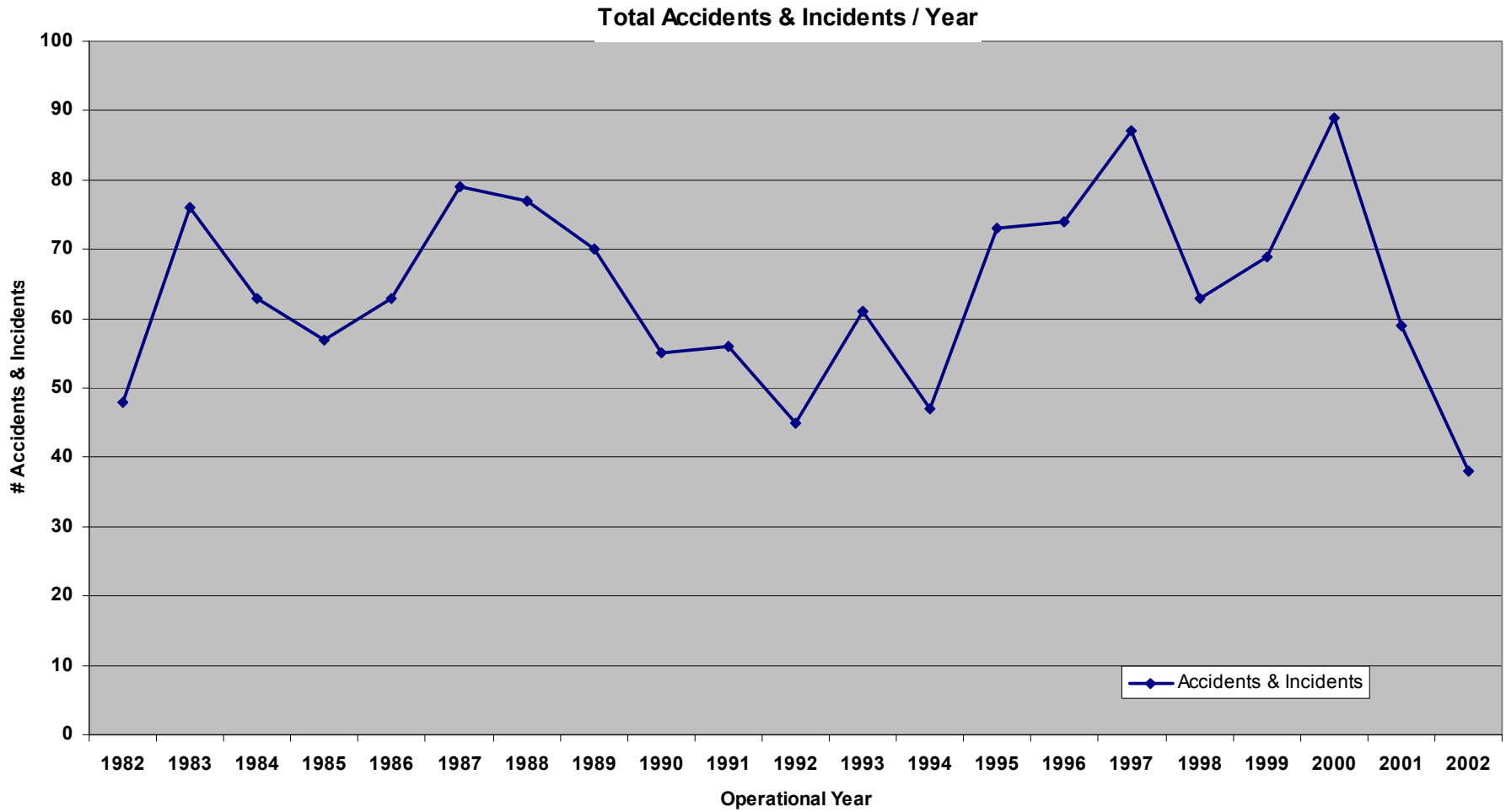
Accidents & Incidents Together



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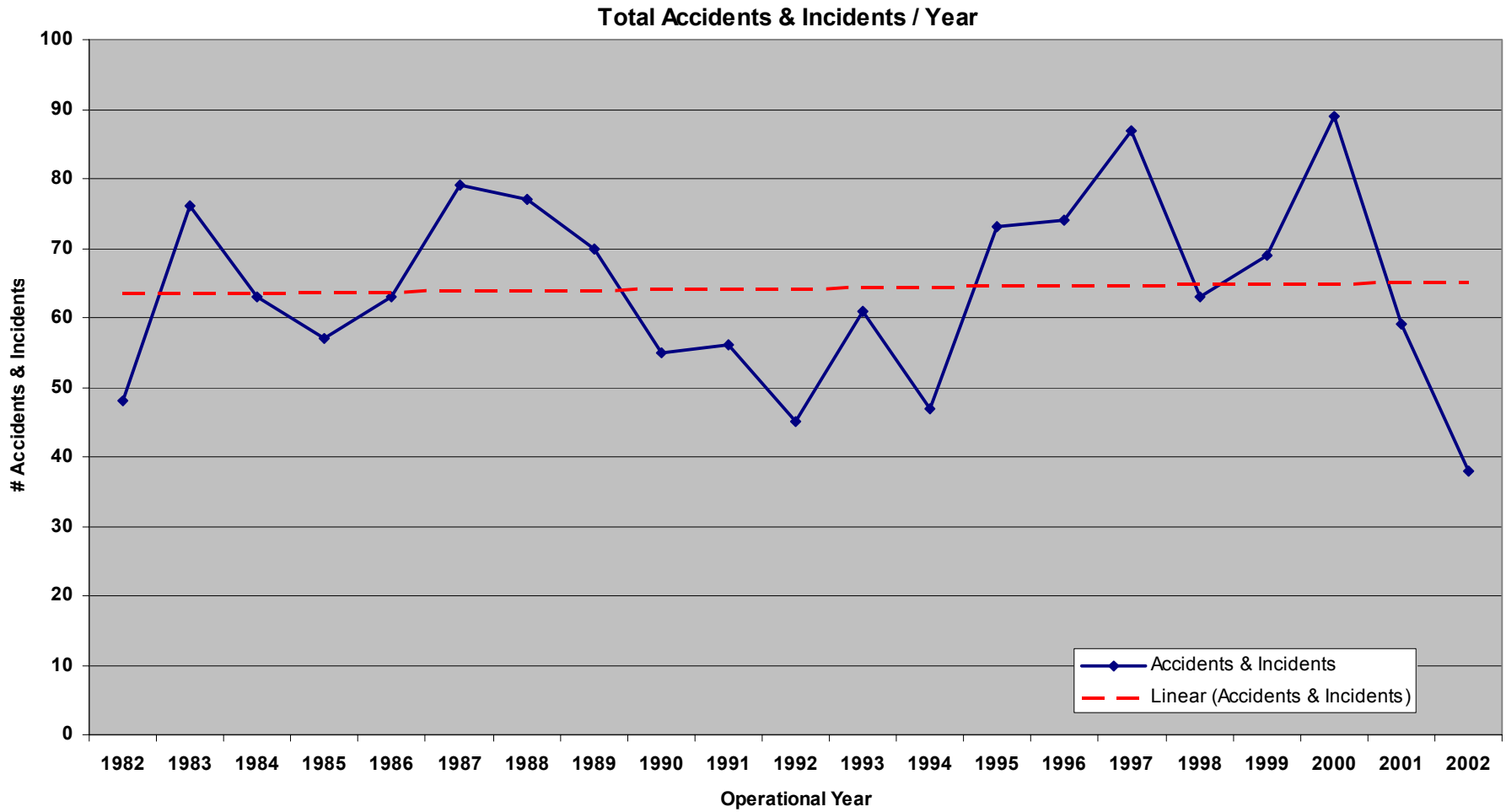

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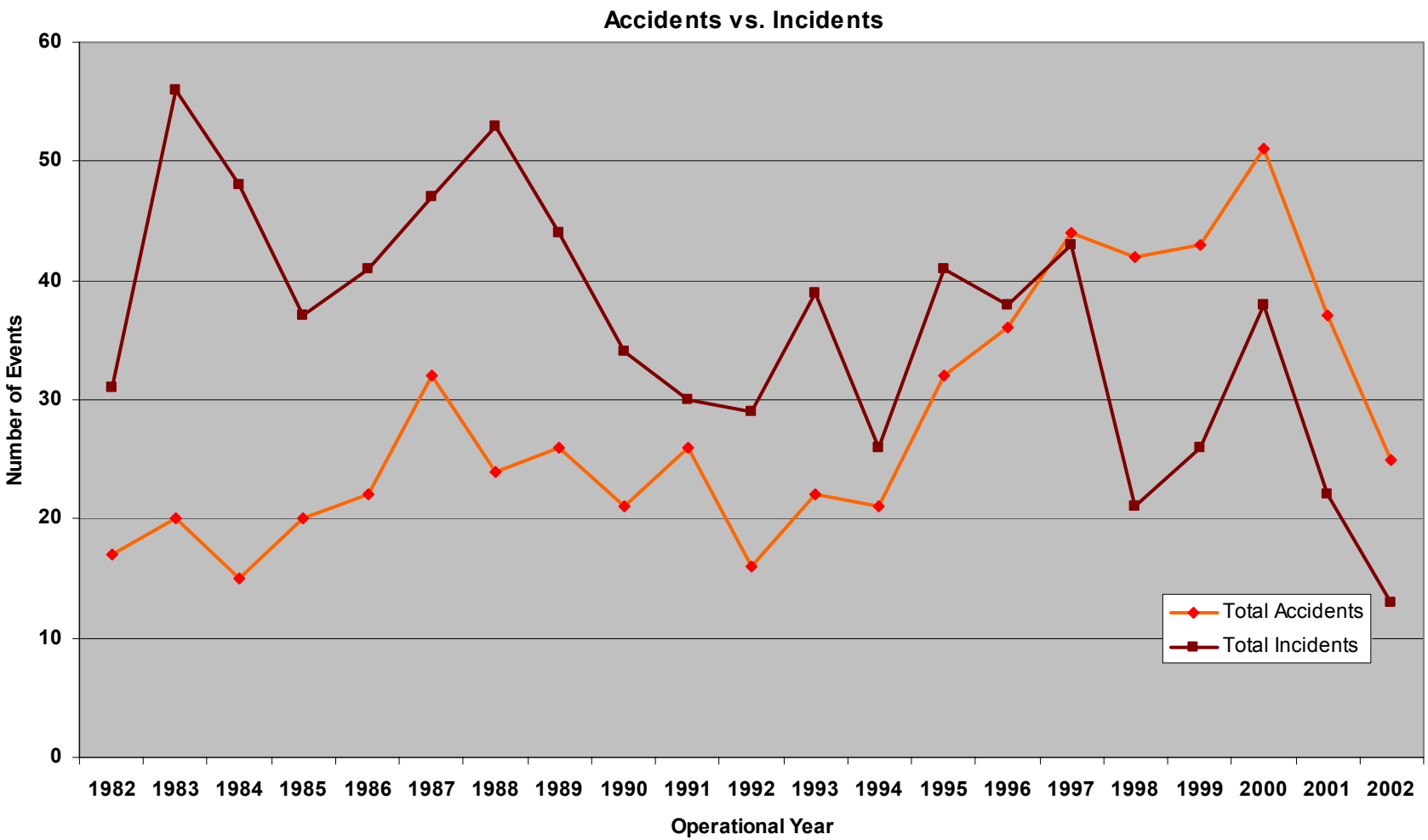
Incidents vs. Accidents Trend



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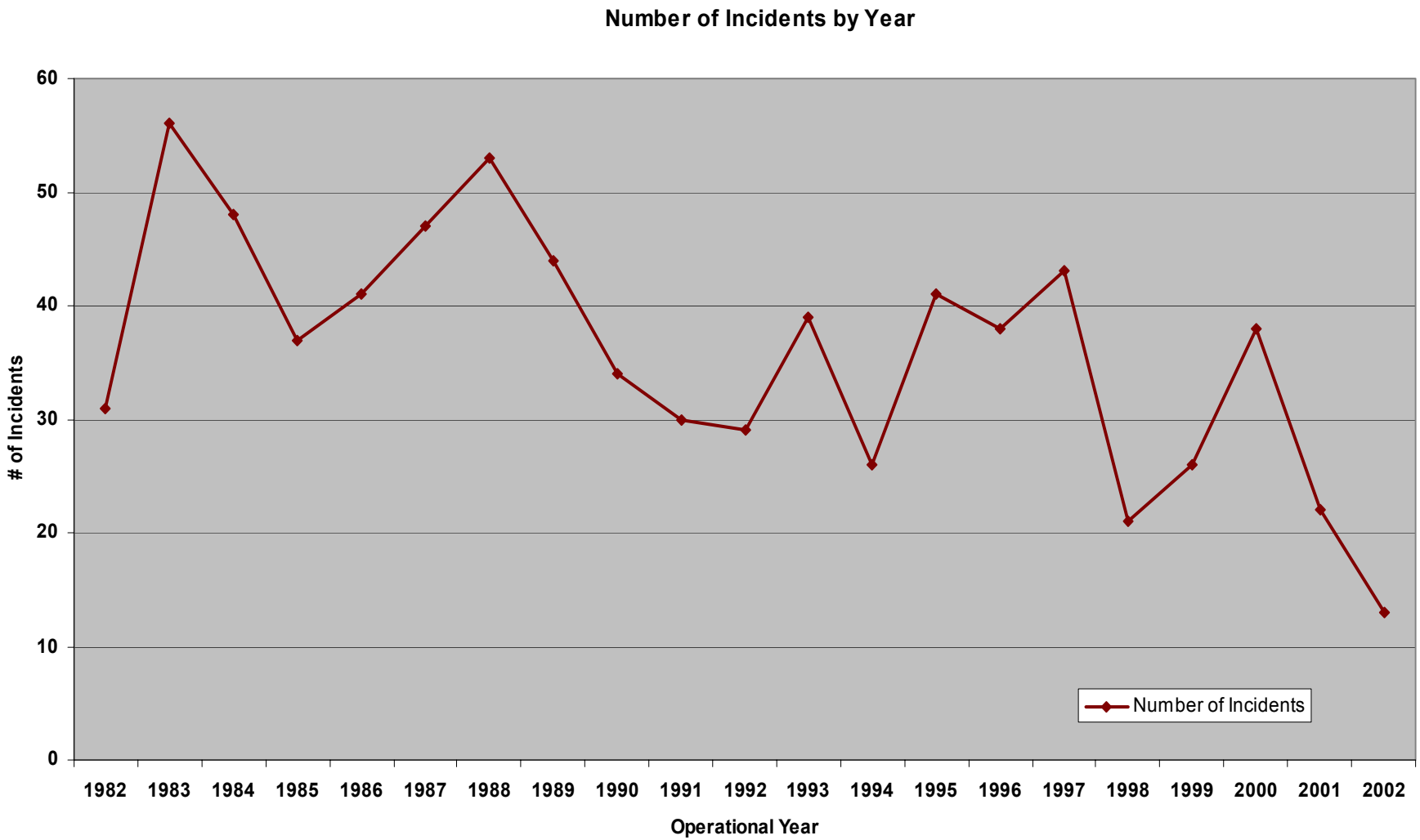
Incident Trend



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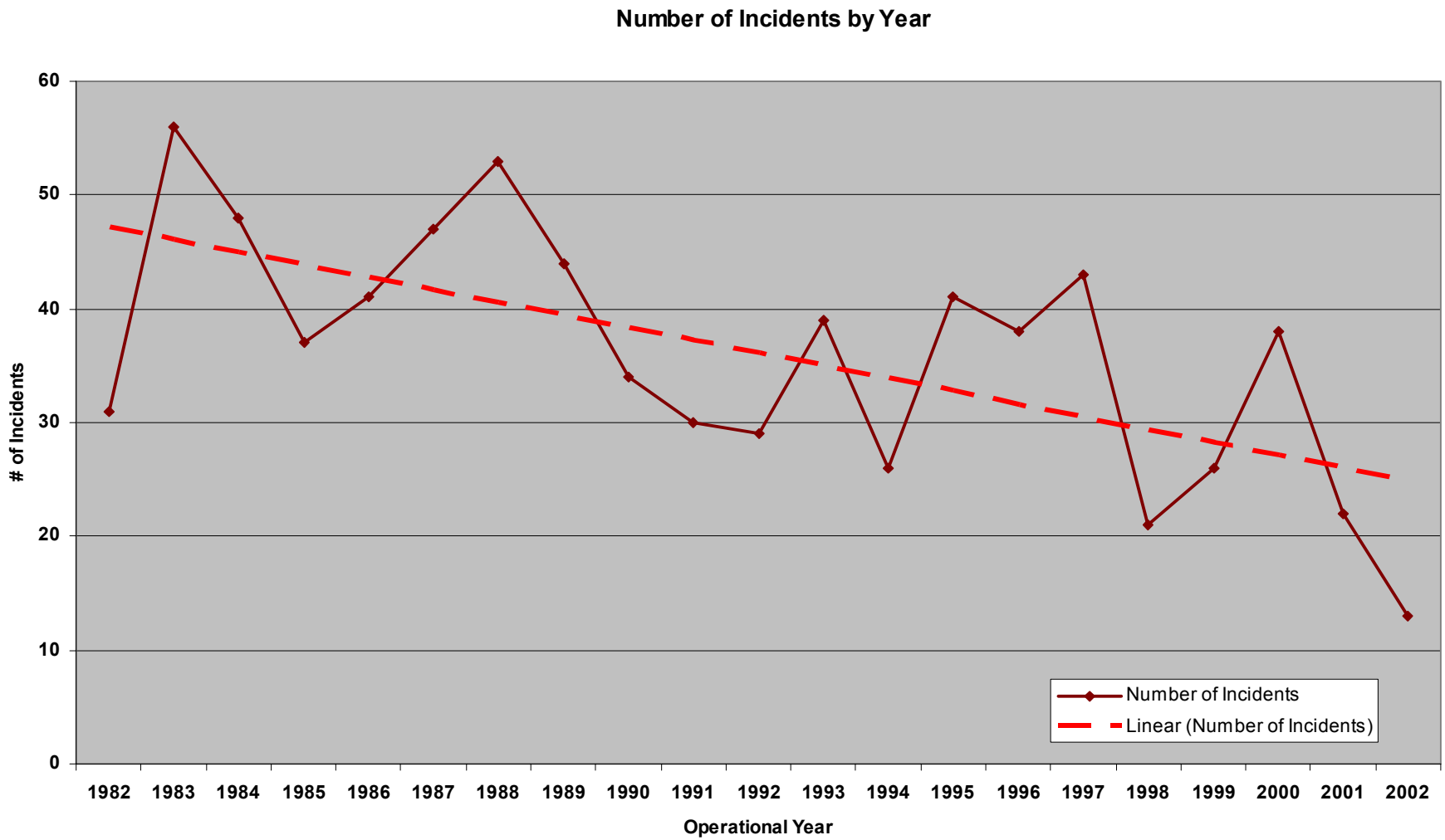
Incident Trend



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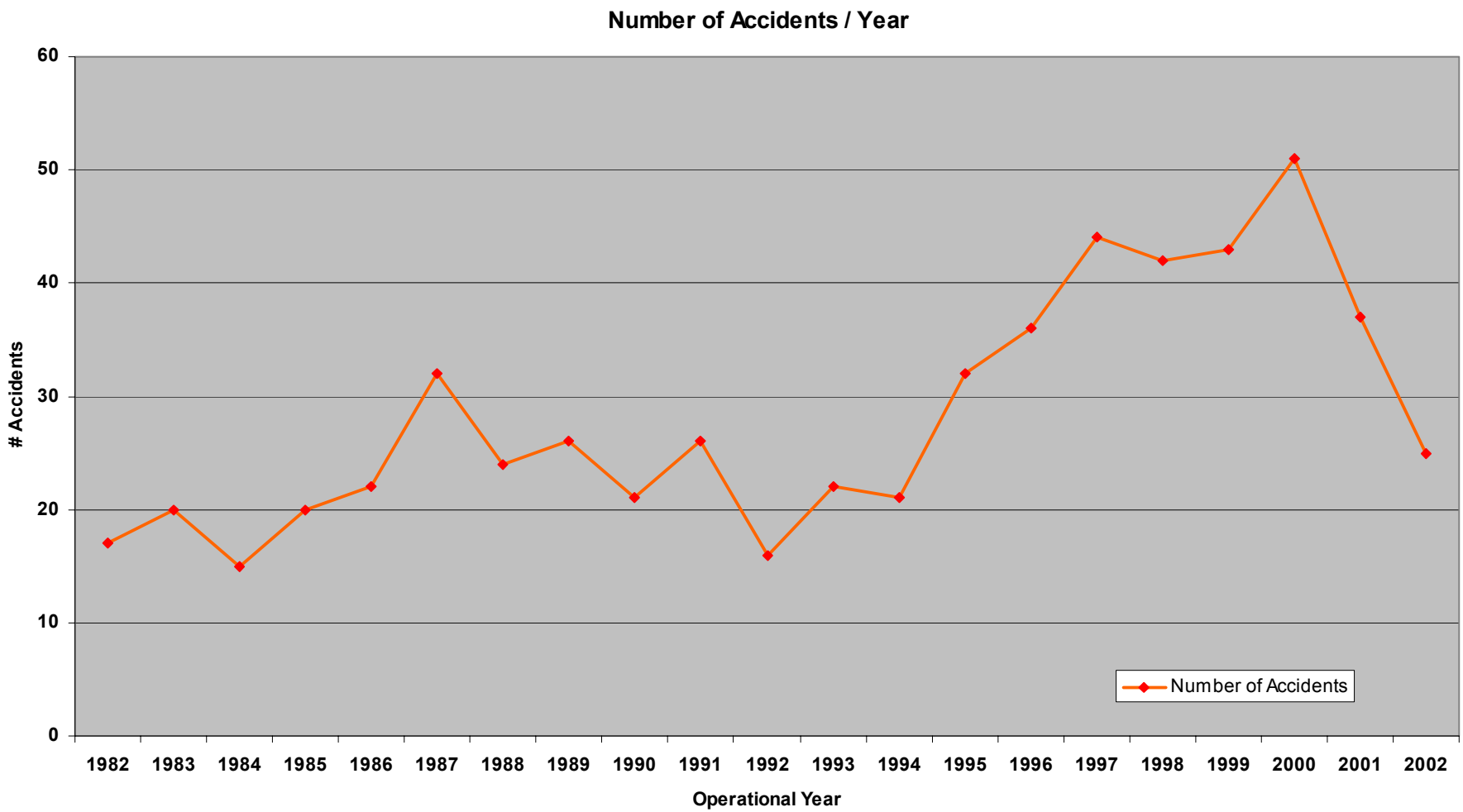
Trend in Total Accidents



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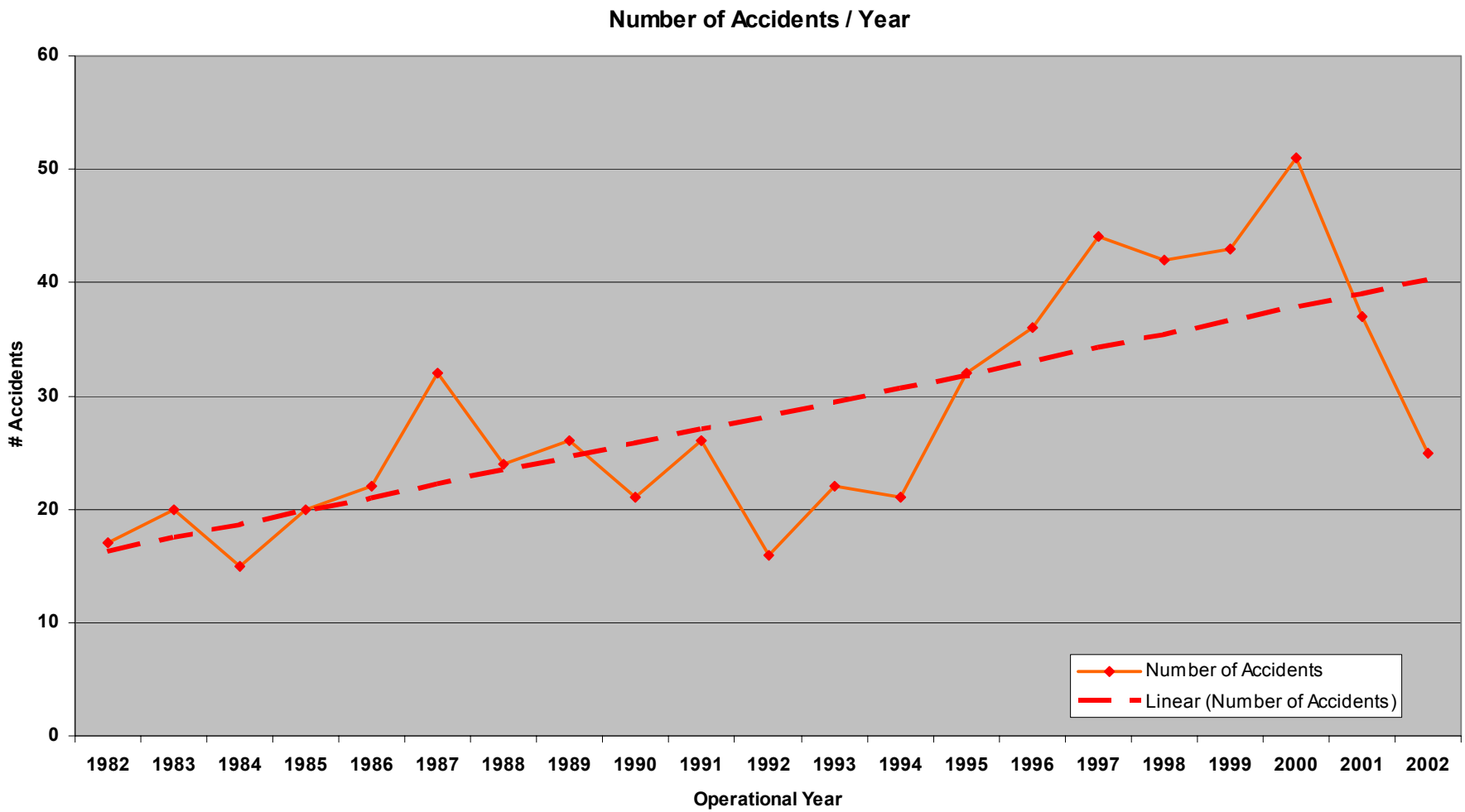

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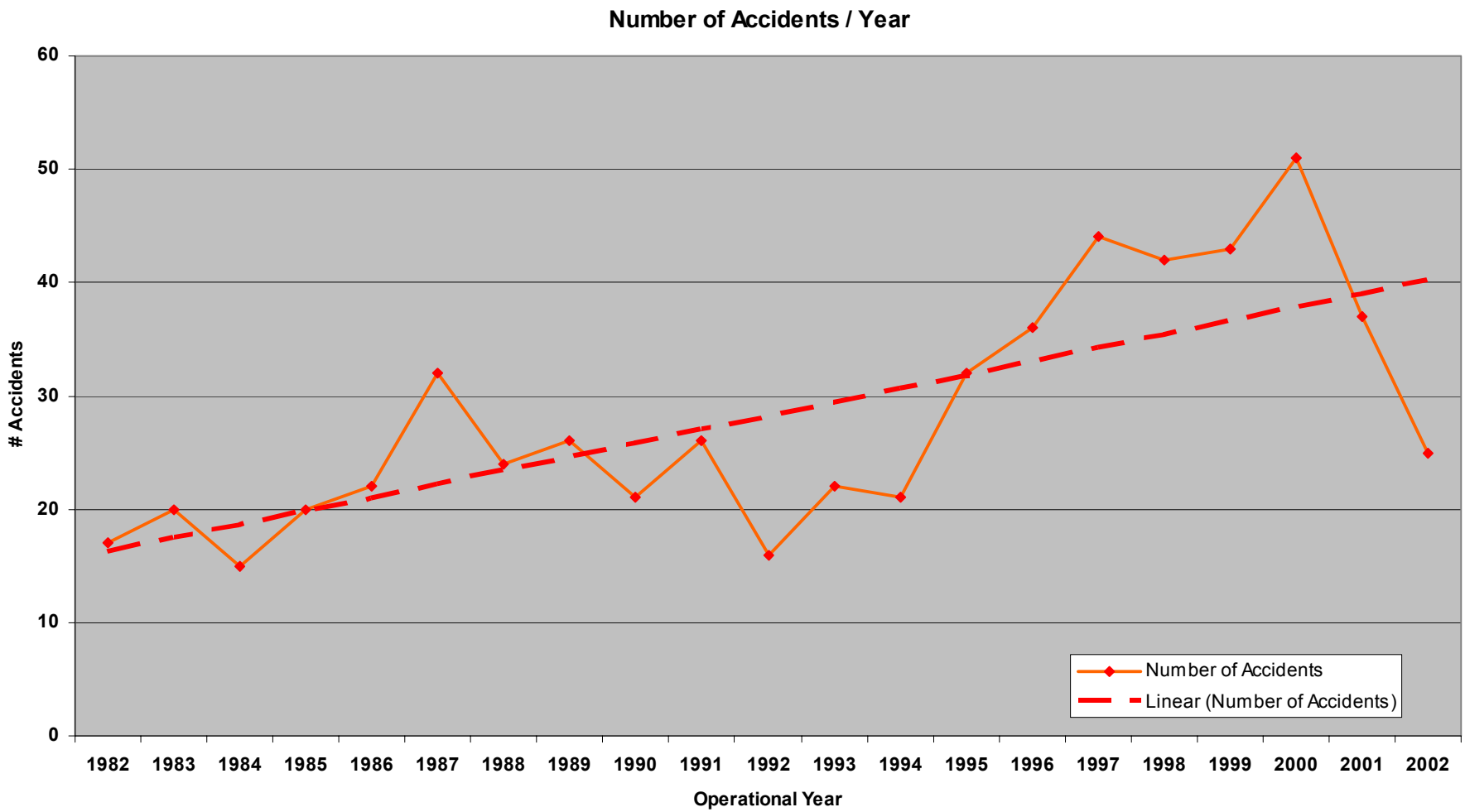

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Study Data Suggests…

While the number of accidents and incidents are remaining relatively the same…

…the criticality of the outcome of such events is becoming more severe.

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Normalizing the Data

Operational Levels vs. Accidents

Re-assessing the data considering
various operational level metrics

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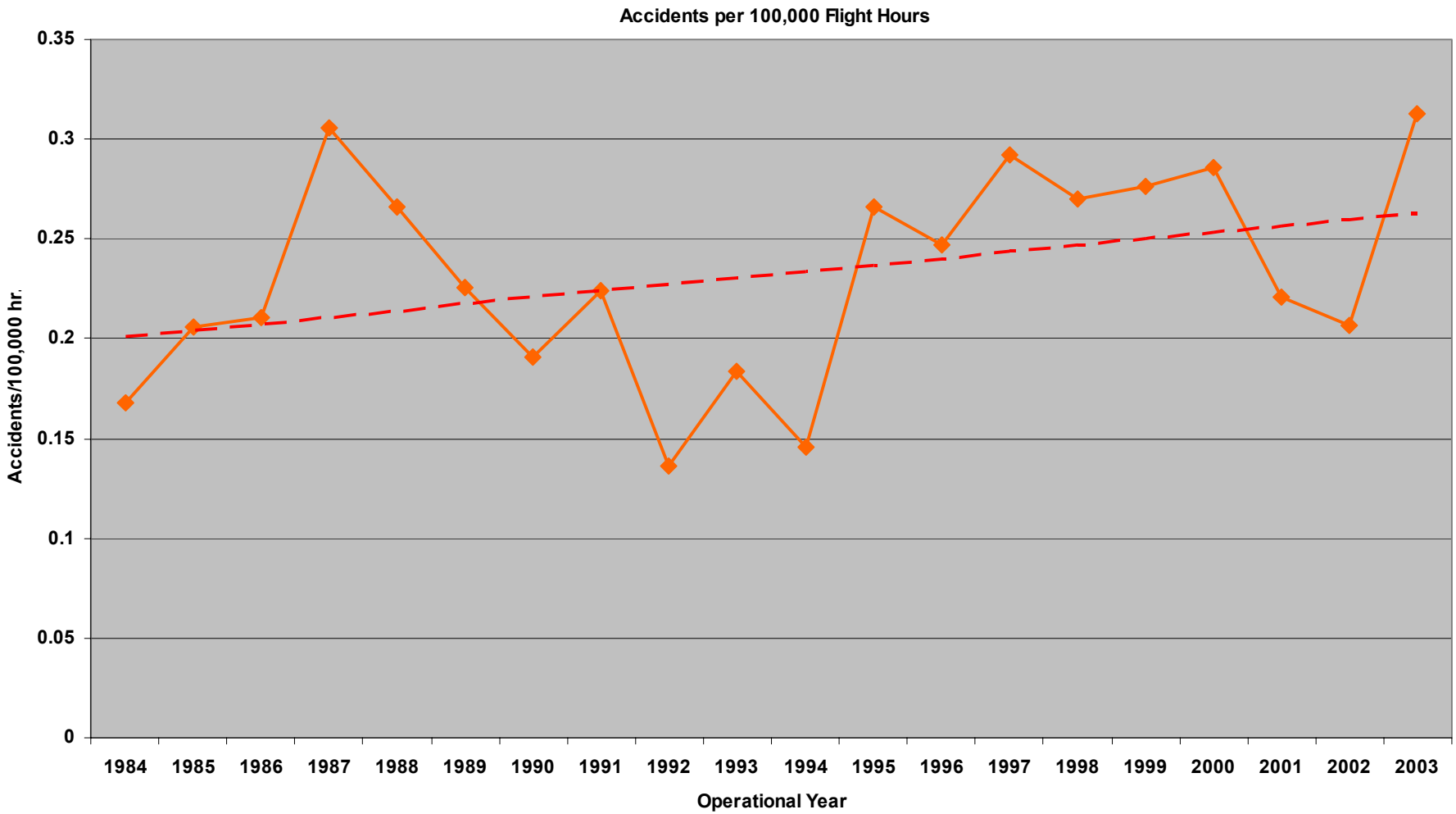
Accidents per 100,000 Flt. Hours



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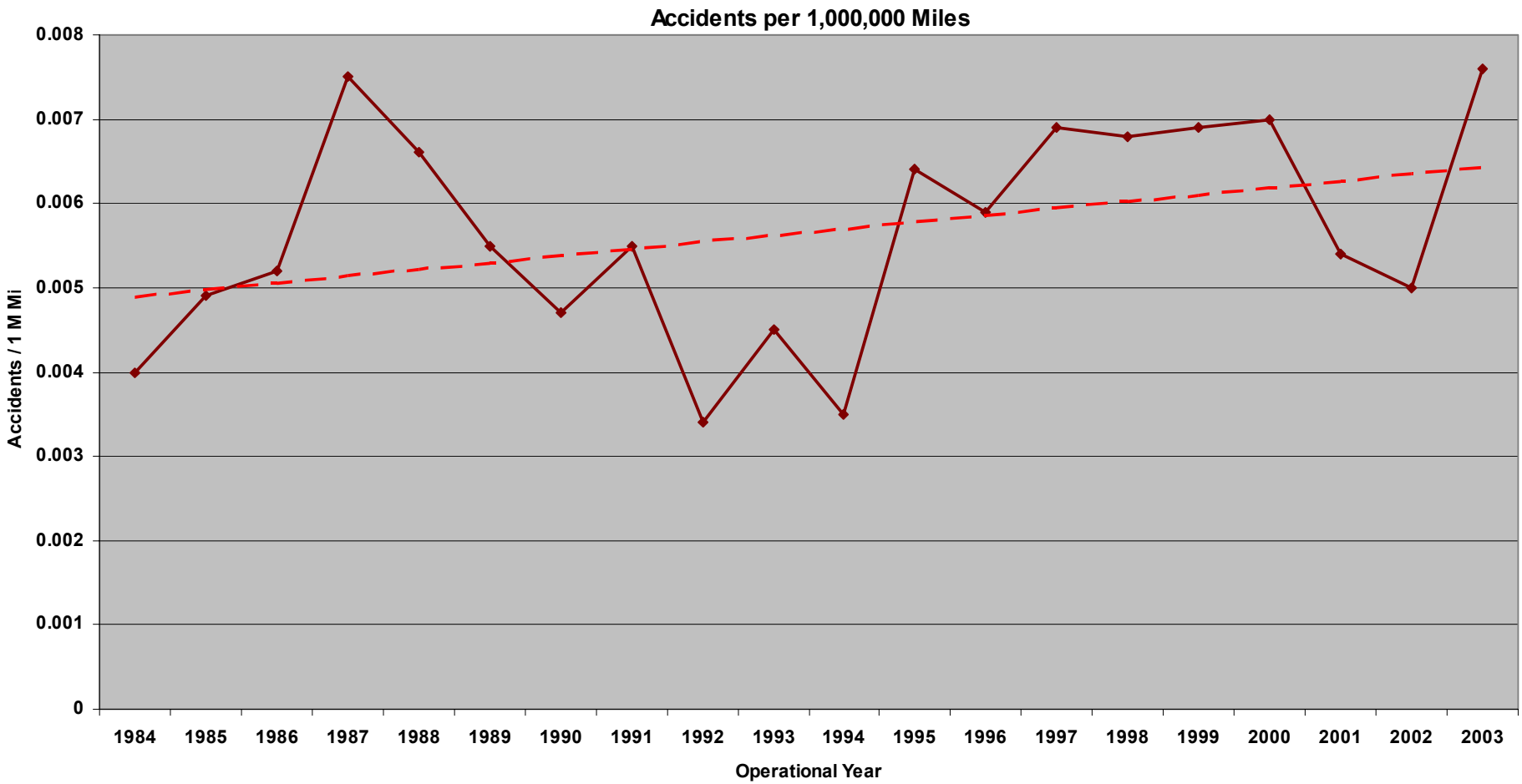
Accidents per 1,000,000 Miles



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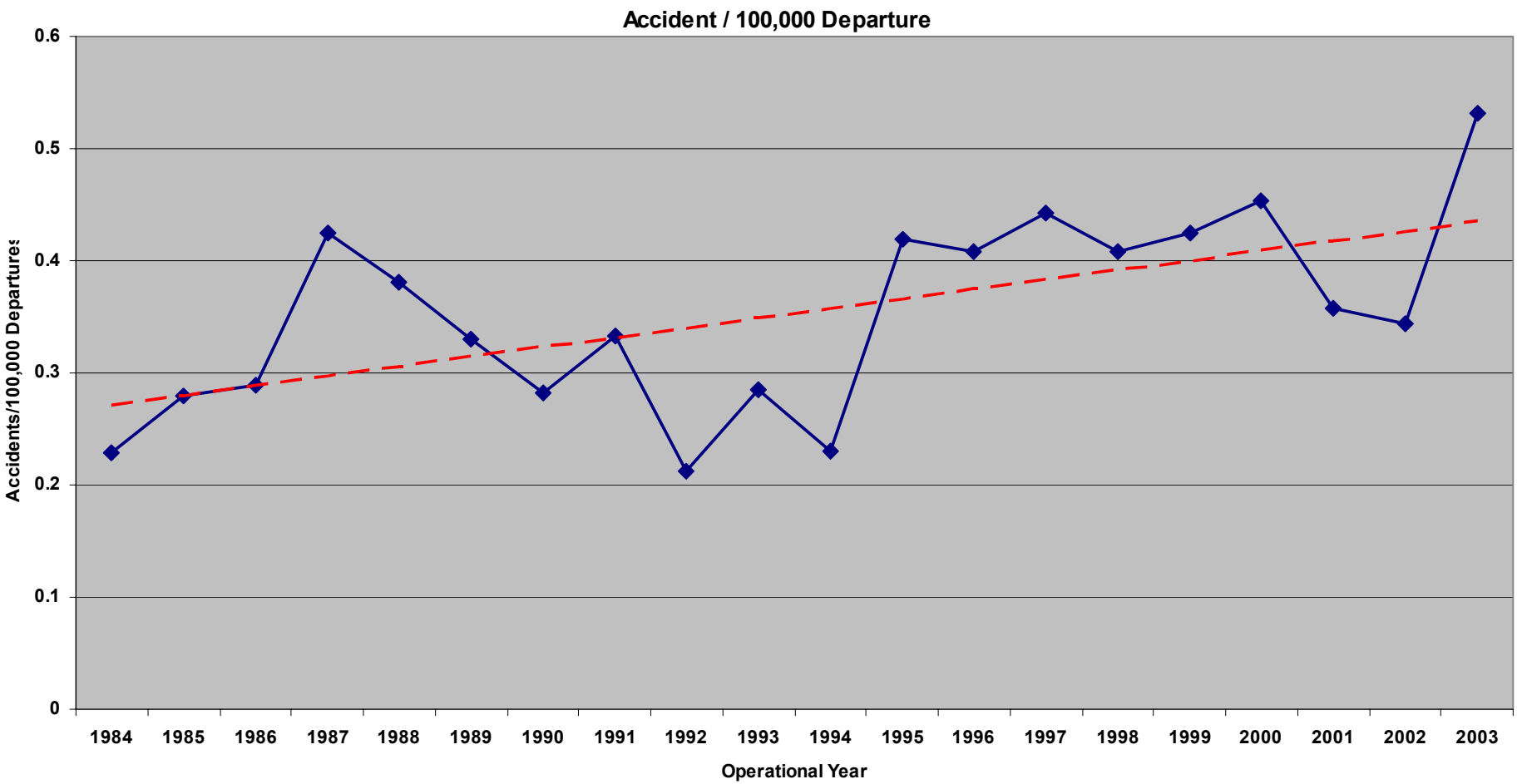
Accidents per 100,000 Departures



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Industry Accident Trends

As a whole, the air carrier industry is experiencing a

slight trend toward becoming less safe

as a mode of transportation.

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Current Safety Systems Challenges

Let's look again at the safety system design and identify areas where improvement could help…

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What Research Experience Suggests

Purdue's Aviation Research Team Projects:

- 11 years of field experience (on-site research)
- Over 28,000 Hours of research observations
- 9 Airlines (All facets of the operation)
- 4 MROs

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More Alike than Different

Despite the diversity of organizations studied…

…all of these operations had surprisingly similar issues when it came to potential safety system improvements.

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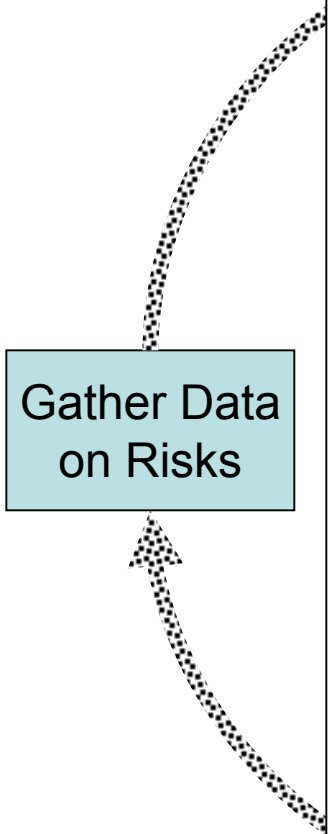

The Problem With Measuring Safety

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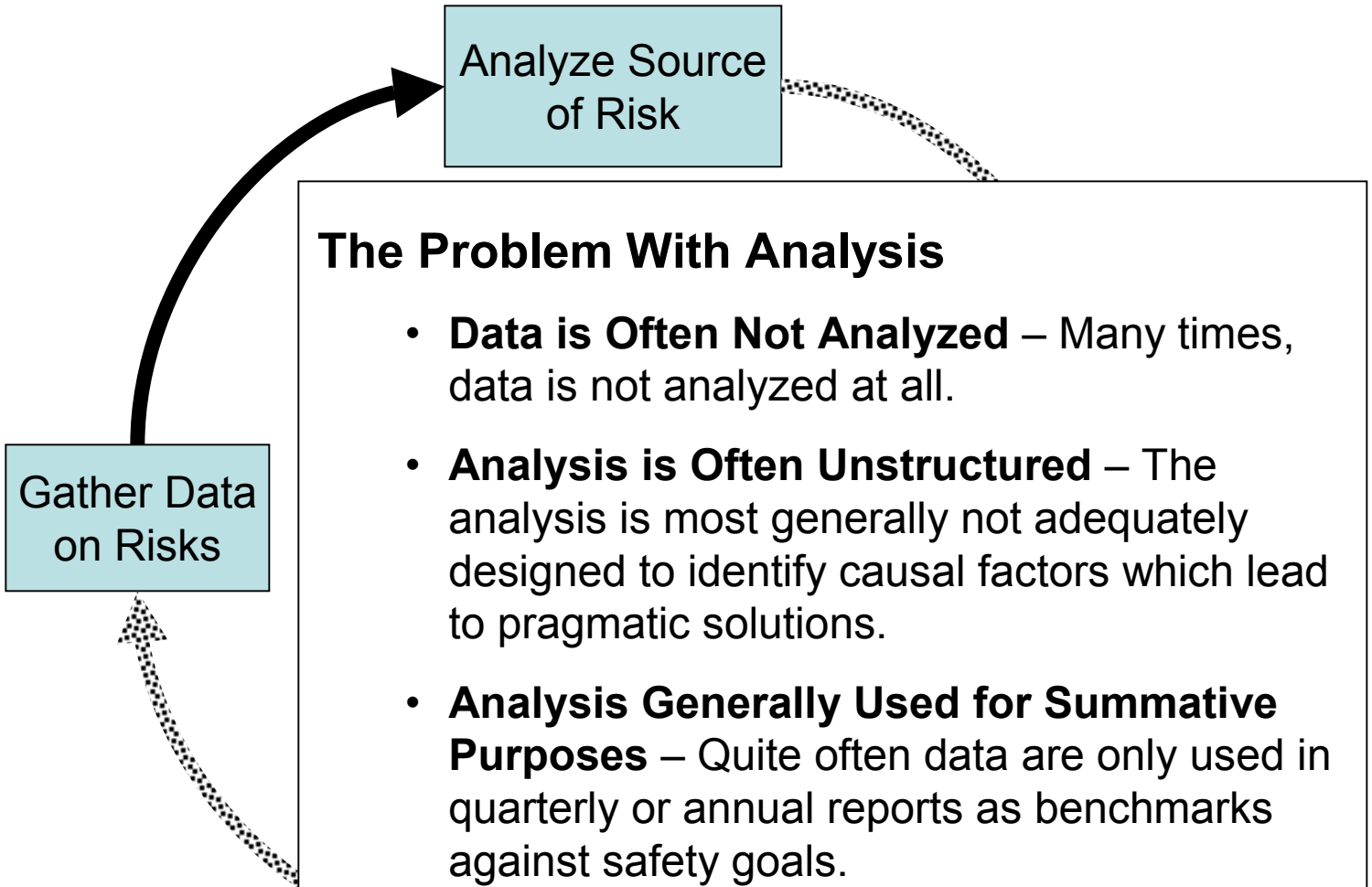

The Problem With Analysis

- **Data is Often Not Analyzed** – Many times, data is not analyzed at all.
- **Analysis is Often Unstructured** – The analysis is most generally not adequately designed to identify causal factors which lead to pragmatic solutions.
- **Analysis Generally Used for Summative Purposes** – Quite often data are only used in quarterly or annual reports as benchmarks against safety goals.
- **Often Does Not Consider Operational Aspects –** What are the implications of operational factors?

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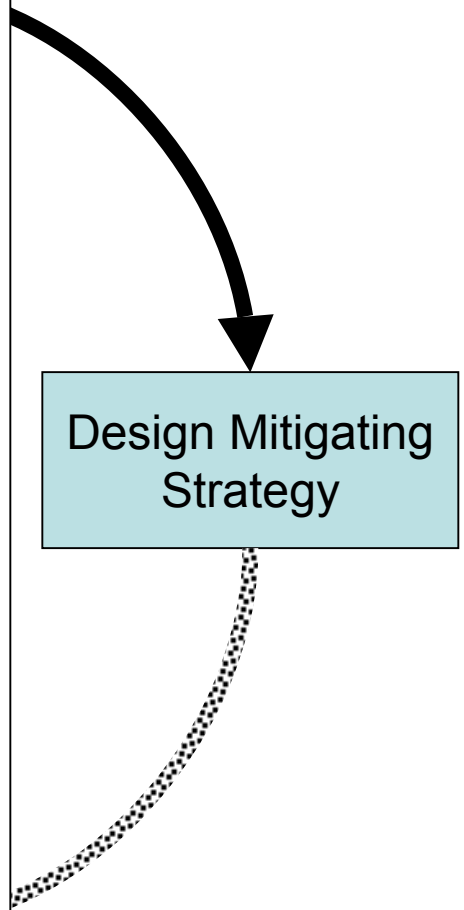
The Problem With Interventions

- **Lead to Local Solutions** – Solutions need to be far reaching rather than local. The organization should "learn" and become safer rather than just the station or department.
- **Don't Address the Cause Factors** – Many times solutions address safety event context rather than root causal factors.
- **Are Often Not Robust in Nature** – Many times interventions address only one facet of the problem. Solutions should address all elements of the problem (i.e. human factors, organizational factors, latent conditions, etc.)



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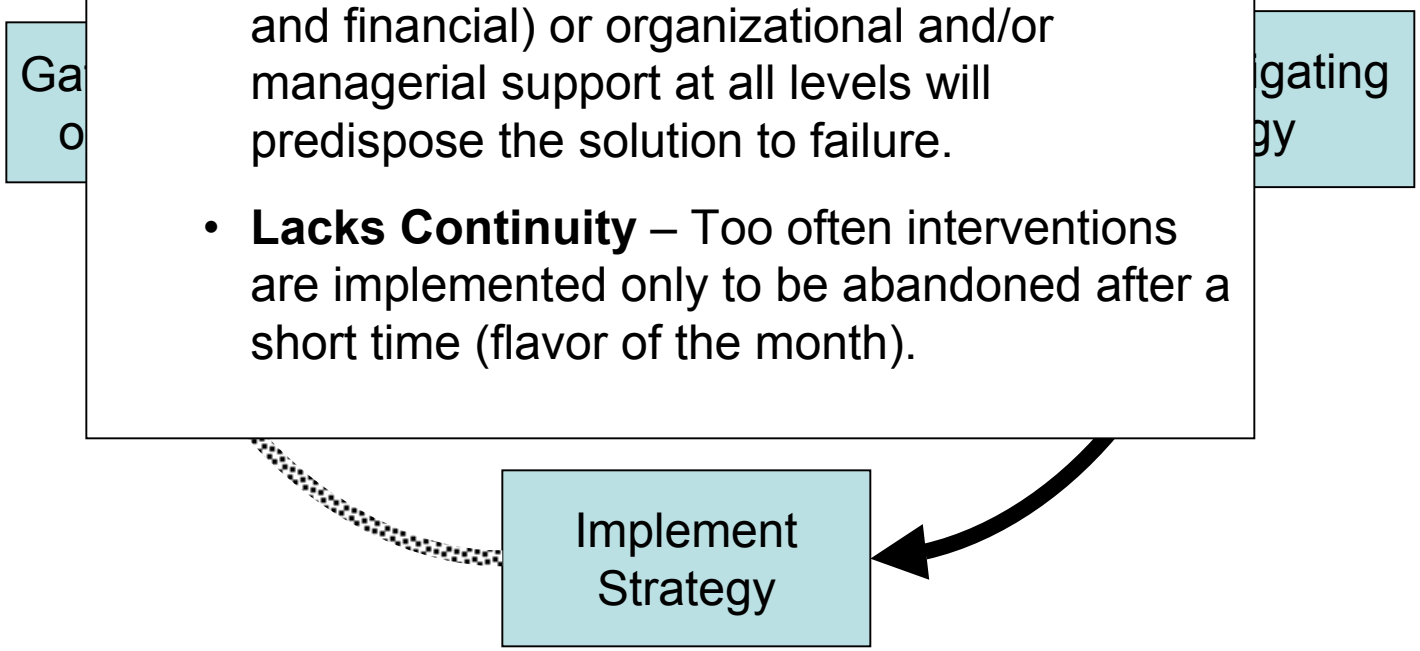
The Problem With Implementation

- **Often Lacks a Well Developed Plan** – To be effective, interventions need to be integrated into the system in a well prepared way which considers all possible impediments.
- **Not Adequately Resourced or Supported** – The lack of either adequate resources (human and financial) or organizational and/or managerial support at all levels will predispose the solution to failure.
- **Lacks Continuity** – Too often interventions are implemented only to be abandoned after a short time (flavor of the month).



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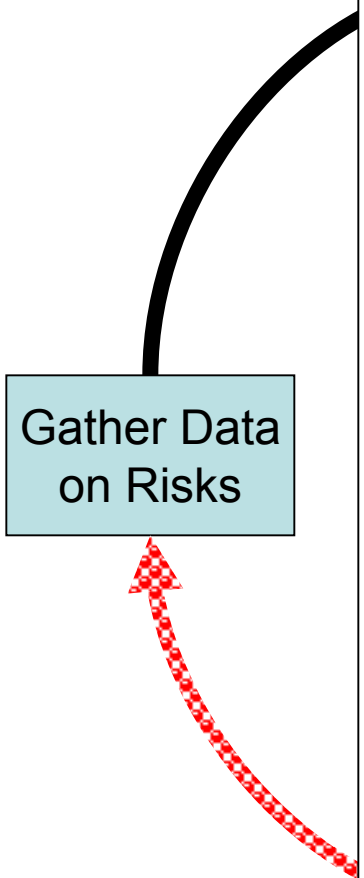

The Problem With Intervention Monitoring

- **Detecting Failed Defenses** – Without constant monitoring, defenses and mitigating strategies can become ineffective and not be discovered.
- **Often Don't Monitor Intervention Effectiveness Over Time** – Solutions effectiveness may change over time due to many factors. While not becoming totally ineffective, they may present varying levels of effectiveness and success.
- **Create New Interventions Rather Than Refine Weak Ones** – Many times if defenses are discovered to be weak new solutions are sought rather than evaluating & refining existing solutions. This adds to complexity and often leads to confusion or conflicts between defenses.

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Continuous Safety Improvement

For the safety system to remain effective, we must:

- Continuously monitor the effectiveness of mitigating strategies
- Analyze intervention weaknesses
- Refine mitigating strategies

Let's take a look at one example

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Robust Risk Reduction Systems

Aviation safety is achieved through the structuring of a system of error & risk reduction strategies…

Defenses in Depth

James Reason, 1990

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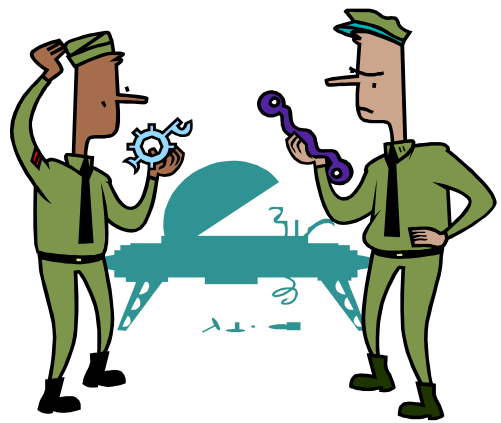
A Closer Look at
Maintenance Data



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Leading Causal Factors

A review of the accident & incident data from the study suggests that several factors were leading contributors

Before reviewing them, let's consider…

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Aviation Safety System

The outstanding safety record of the airline industry is due in great part to a well structured strategy of layered defenses that…

- Prevent
- Capture
- Or Recover

from accident generating errors & conditions

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Defenses in Depth

Dr. James Reason characterizes this strategy as "defenses-in-depth". The airline industry uses a series of layered defenses to keep accident generating errors from reaching fruition.

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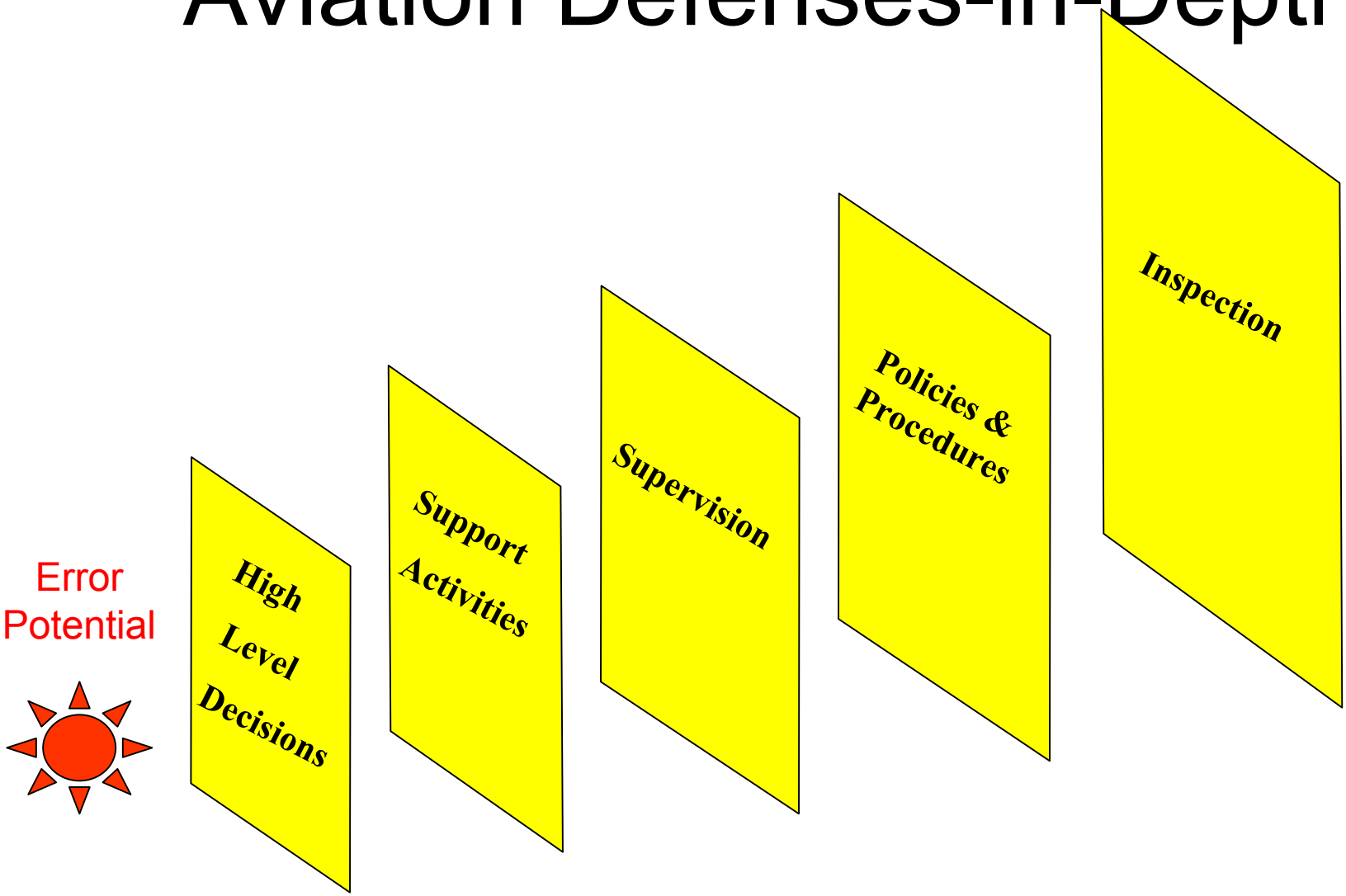
Aviation Defenses-in-Depth



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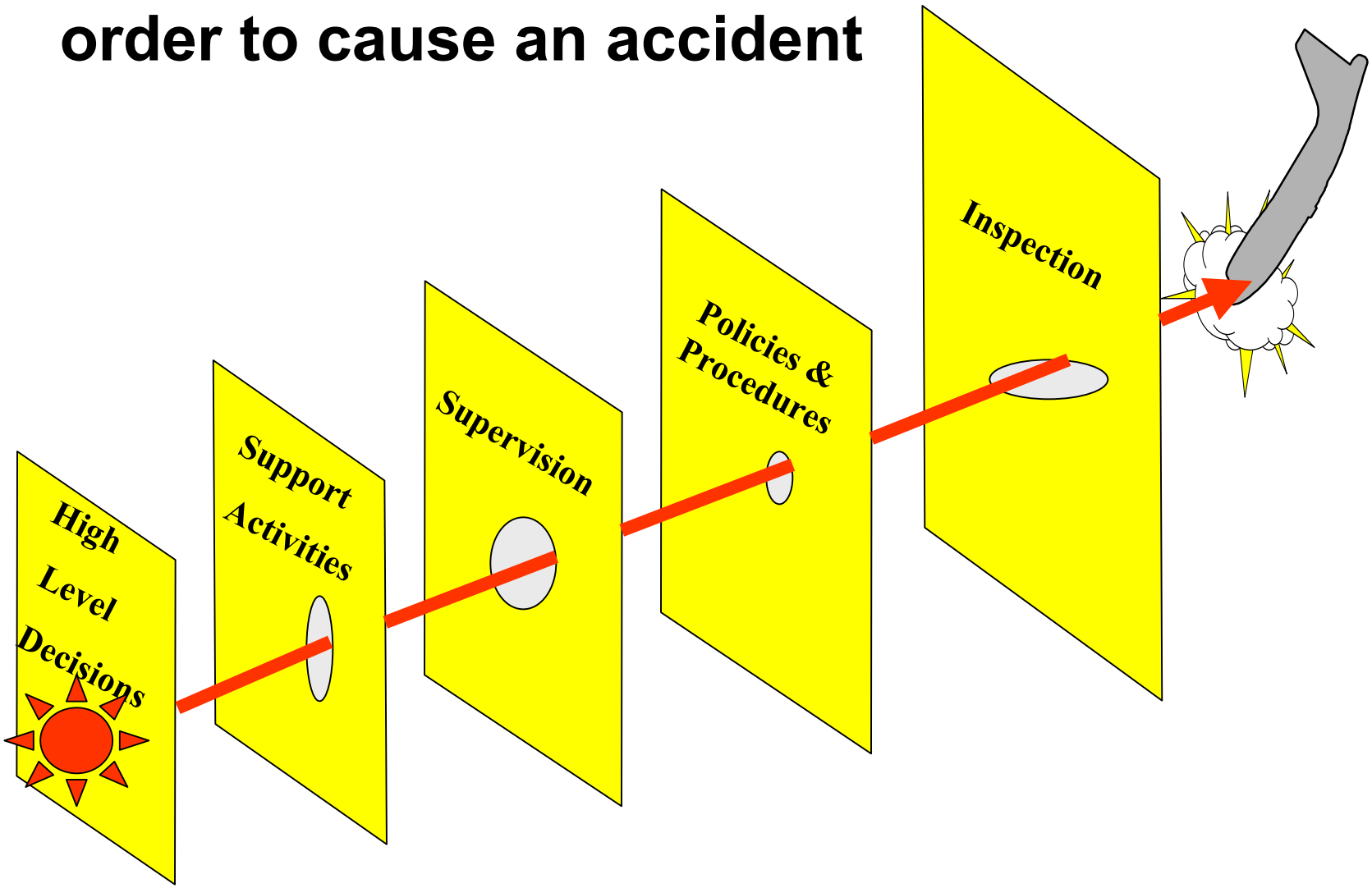
Errors must breach all defenses in order to cause an accident



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Opacity of Failed Defenses

Dr. Reason cautions that a system of “defenses in depth” has the potential to hide defenses that are not doing their job…

…in other words, defenses can be breached without detection under normal conditions

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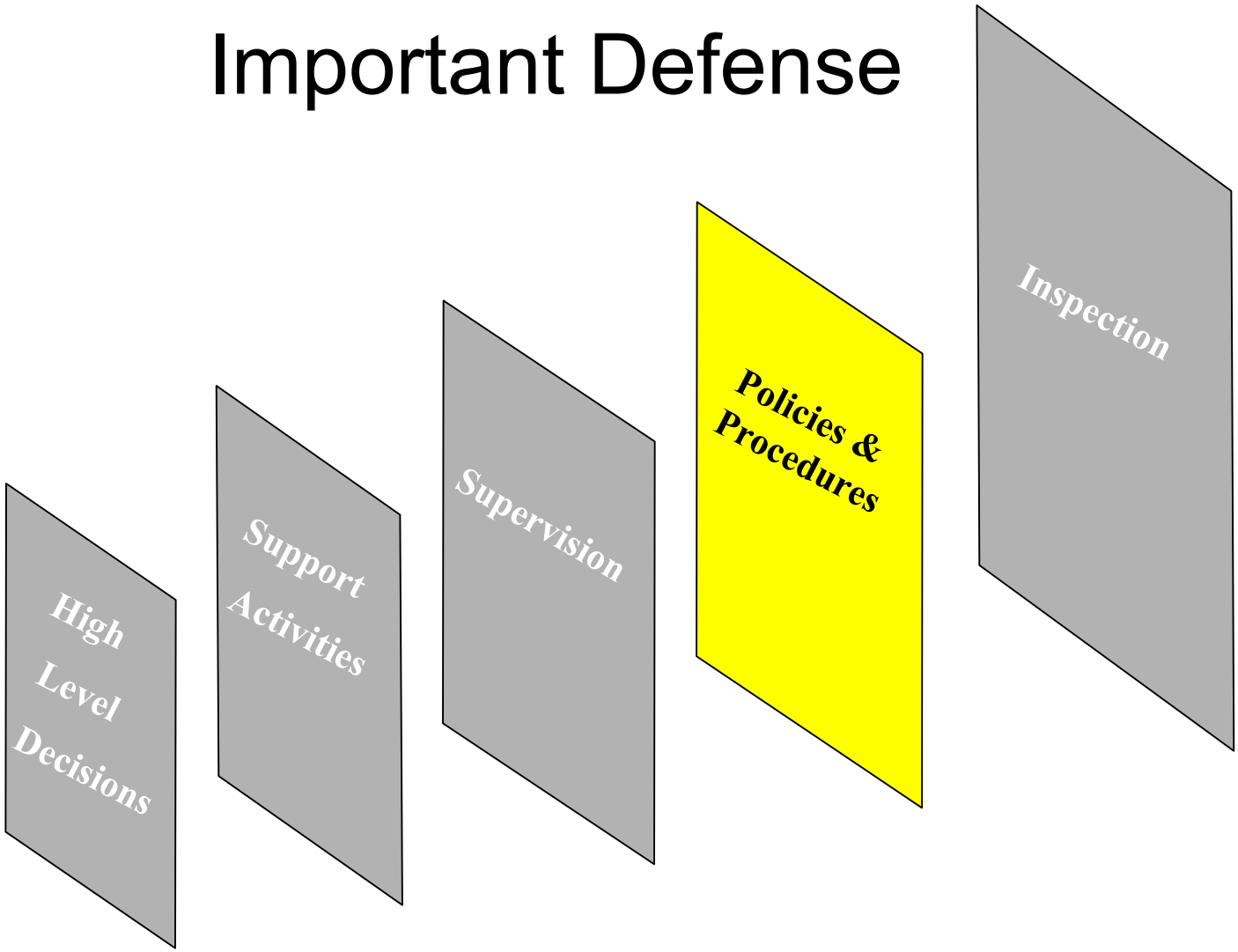
Policies & Procedures as an Important Defense



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Work Standards as Defenses

Among the most effective defenses against errors are work related:

- Procedures
- Policies
- Industry Work Standards (AC 43.13, Maintenance Manuals, etc.)

Properly constructed, they are known paths to success.

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Study Data Suggests…

A review of maintenance related event data in the study showed that…

76.5%

… had *failure to follow established procedures* as a contributing factors

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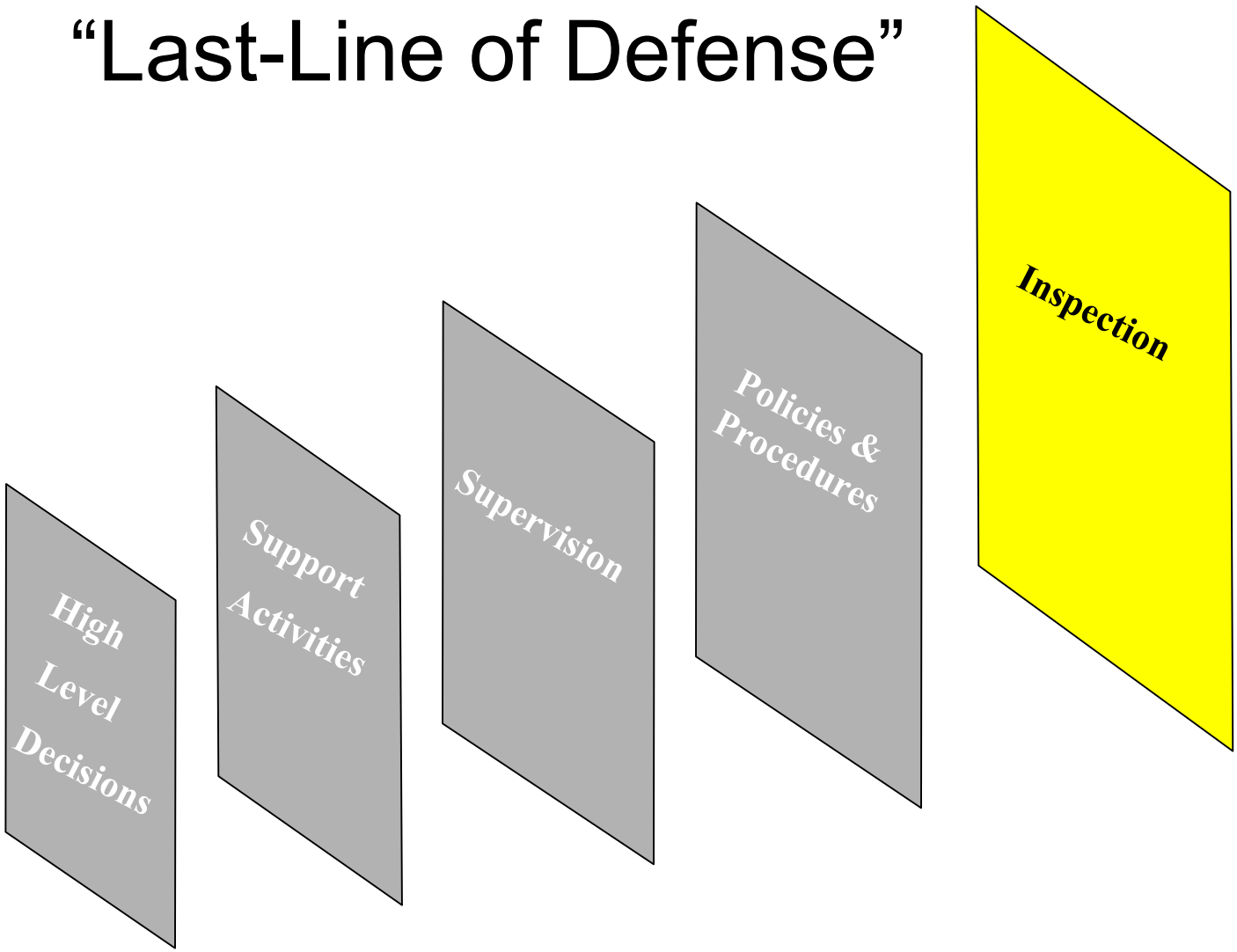
Inspection is Often the "Last-Line of Defense"



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Study Data Showed that…

Inadequate or missing inspection was a contributing factor in …

19.8%

… of the maintenance related accidents and incidents.

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Organizational Factors

The study also demonstrated that individuals are not the only major contributors to maintenance related accidents.

Failure of the organization to meet their safety roles and responsibility was the third leading contributor.

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Organizational Contribution

Organizational factors such as incorrect or inadequate procedures, maintenance program inadequacies, or failed supervision accounted for …

15.2%

… of the maintenance related contributions to accidents and incidents.

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Not an Uncommon Occurrence

It's not uncommon for the best intended intervention strategies to be:

- ***Not completely effective*** – we tend to make new ones rather than refine existing ones
- ***Lose their effectiveness*** over time – we often fail to recognize the deterioration
- And, we often don't have a "system" designed to ***detect failed defenses*** within the "defenses in depth" strategy

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Moving Toward an Effective Safety System

Working with Industry to find solutions…

Purdue University Research Team Tools and

Strategies Designed to Help Industry

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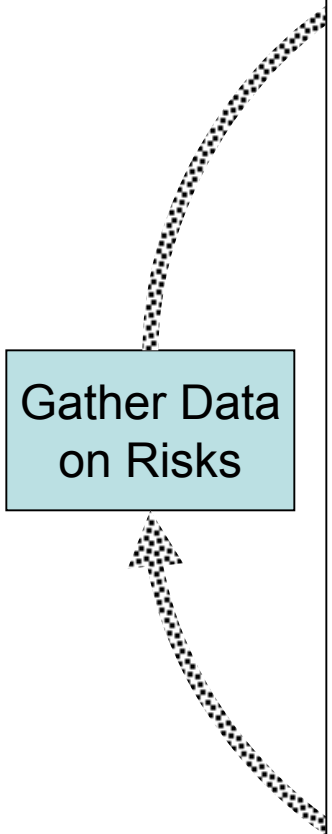

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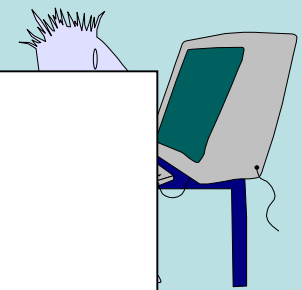
At-Risk Safety Metric



Program Software Availability

Safety Metric software is available at:

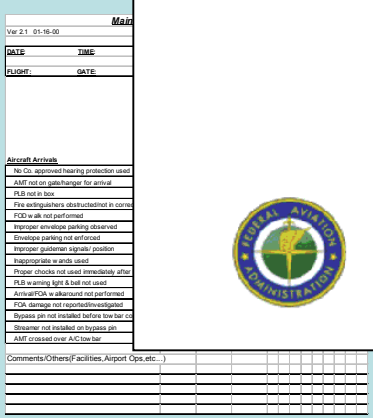
www.tech.purdue.edu/at/resources

Choose: Human Factors Research Team

Then: Products

Software

Also at: http://hfskyway.faa.gov



Research grant provided by the Federal Aviation Administration, Office of Aviation Medicine

- Provided immediate feedback and safety mentoring to workers

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Process Mapping Benefits Include

- Helps establish roles and responsibilities
- Defines process ownership & accountability
- Promotes better communication & coordination
- Is a foundation for continuous improvement
- Fosters more informed decision making
- Generates more efficient resource utilization

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Coming soon!

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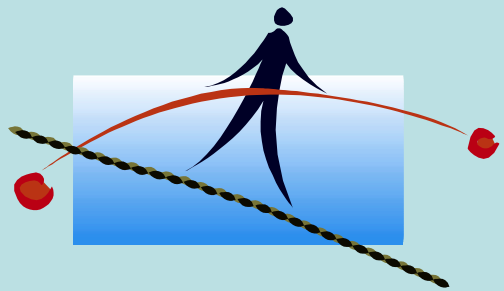
Insuring Implementation Success Through

Human Performance Shaping



20%
Antecedents

Behavior

80%
Consequences

1. Positive *-or-* Negative
2. Immediate *-or-* Future
3. Certain *-or-* Uncertain

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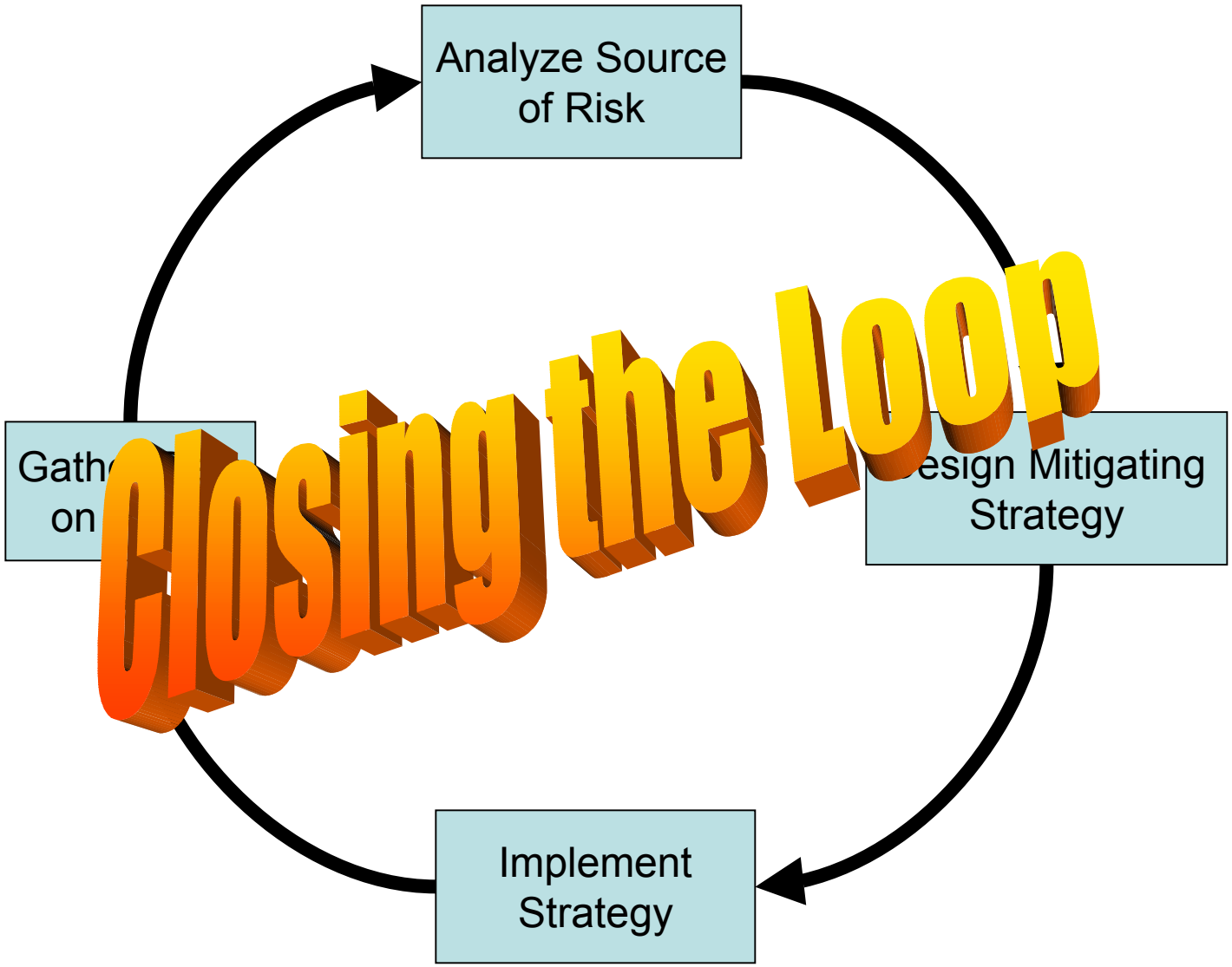

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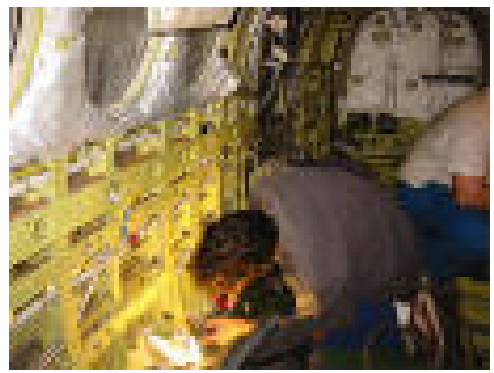
Student Research Teams Working With Aviation Industry Partners World-Wide



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Thank You

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