
# Leaning Forward
# Developing a Risk Based Safety System

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31 Years



1995


1998

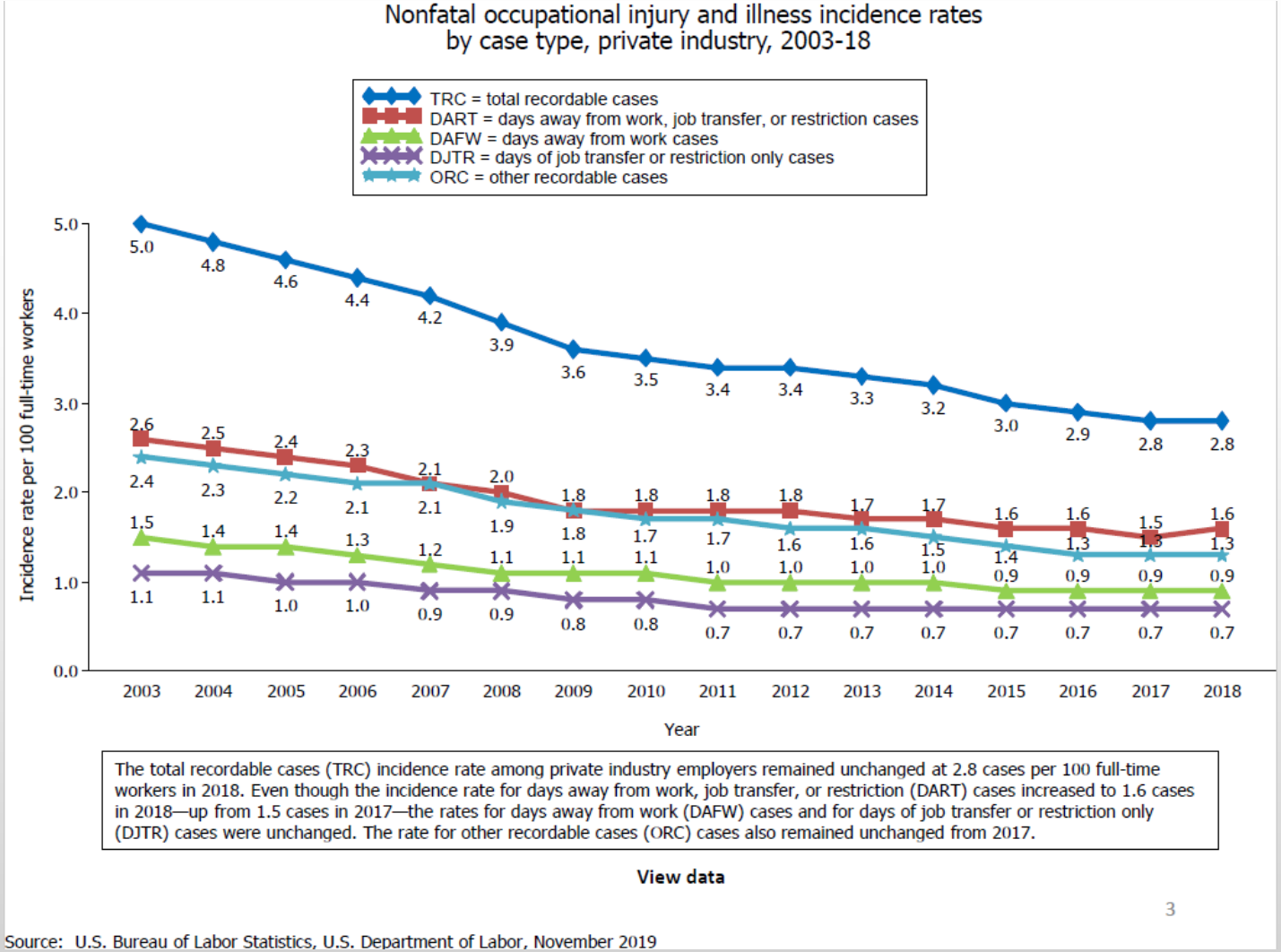
**European Framework Directive on Safety and Health at Work (Directive 89/391 EEC)**

- The Directive obliges employers to take appropriate preventive measures to make work safer and healthier.
- The Directive introduces as a key element the principle of risk assessment and defines its main elements (e.g. hazard identification, worker participation, introduction of adequate measures with the priority of eliminating risk at source, documentation and periodical re-assessment of workplace hazards).

# Agenda

- Establishing Basis for Risk-Based Safety Systems
- Examples of Risk-Based Safety Systems in Practice
- A View Based on Experience and the Experience of Others

# Safety – The Current State




Source: U.S. Bureau of Labor Statistics, U.S. Department of Labor, November 2019

- Safety professionals have done a great job!
- Regulations set a *minimum*, yet enforceable, standard.
- The trend is flattening. (We will discuss serious incidents later)
- How do we take the next steps to sustain improvements and push the curve down?

# A **VERY** Broad History Lesson RE: US Safety

- Safety Out of Necessity
- Broad-Based Regulations/Compensation with the Industrial Revolution
- OSH Act 1971
- Continued Refinements and Experiments
    - Consensus Standards
    - Incentives
    - Behavioral-Based Safety
    - Many Others
- Risk-Based Safety Systems
    - The **system safety** concept calls for a risk management strategy based on identification, analysis of hazards and application of remedial controls using a systems-based approach.[1] This is different from traditional safety strategies which rely on control of conditions and causes of an accident based either on the epidemiological analysis or as a result of investigation of individual past accidents. (https://en.wikipedia.org/wiki/System_safety)

Risk is a term most Sr. Management will understand/relate to.

# A **VERY** Quick Review to set a Baseline Define Hazard & Risk

- What is a Hazard?
- What is Risk?
- What is Safety?

# Simple Distinction

# Define Hazard & Risk

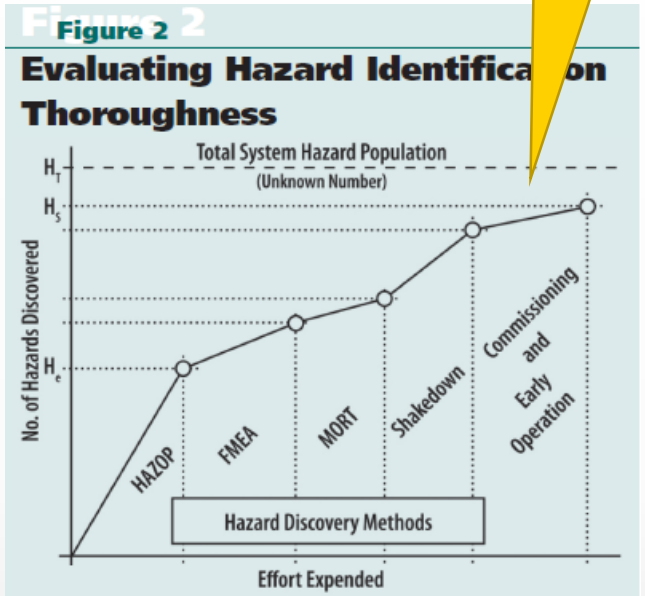
- What is a Hazard? – A Paranoid Endeavor
    - A condition, set of circumstances, or inherent property that can cause injury, illness or death. ANSI Z10
    - Something that can cause harm
        - Harm: physical or mental damage (or property, reputation, status)
- What is Risk? – A Reasoned Analysis
    - An estimate of the combination of the likelihood of an occurrence of a hazardous event or exposure, and the severity of injury or illness that may be caused by the event exposure. ANSI Z10
    - An estimation of exposure to a hazard and resulting harm.
- What is Safety
    - Freedom from harm or danger. The state of being safe. The state of not being dangerous or harmful. A place that is free from harm or danger. A safe place.

# Finding All The Hazards

Cantrell & Clemens, Professional Safety 2009

- Most important step.
  - “If you can’t find hazards, you can’t practice systems safety”.
- Often taken for granted. Less formalized.
- Waiting for a loss event is waiting too long.
- Can we ever find all of the hazards?
- Different system types lend themselves to different techniques. Consider multiple techniques
- Consider multiple analysts

Total Never Reached




*Note. Adapted from “Quality Control in Safety and Risk Analysis,” by J. Suokas and R. Veikko, April 1989,* Journal of Loss Prevention in Process Industry, 2, *pp. 67-77.*

**Promoting Thoroughness**

Several methods improve the thoroughness of hazard identification:

- Use of several complementary identification approaches.
- Use of more than one analyst.
- Special wariness of systems employing new technology or old technology in new ways, or change of operating environment.
- Developing a high degree of system savvy through:
  a) design studies;
  b) inspections and real or virtual operational walk-throughs;
  c) user/operator interviews;
  d) studies of mishap performance records of like systems.

Cantrell, Clemmons, Professional Safety Nov 2009

# How Do We Find the Hazards?

- Incident Analysis
- Process Review
- Safety System Review
- Physical Inspections
- Checklists
- Observations
  - Job Hazard Analysis etc
- Industrial Hygiene
- Hazard Operability Studies
- Walkthrough
- Perception Surveys
- Bureau of Labor Statistics
- ANSI Standards

- US and International Standards & Regulations
- Equipment Manuals
- Industry/Trade Association
- Research
- Long Term Health Effects
- Qualitative/Quantitative Assessments
- Consider ancillary activities and populations.
- **Ask those closest to the work!!!!!!!!!**

## An Ongoing Process

# Moving from Event to a System
# ANSI Z690.3 - 2011

Hazards Identified, we assess risk.

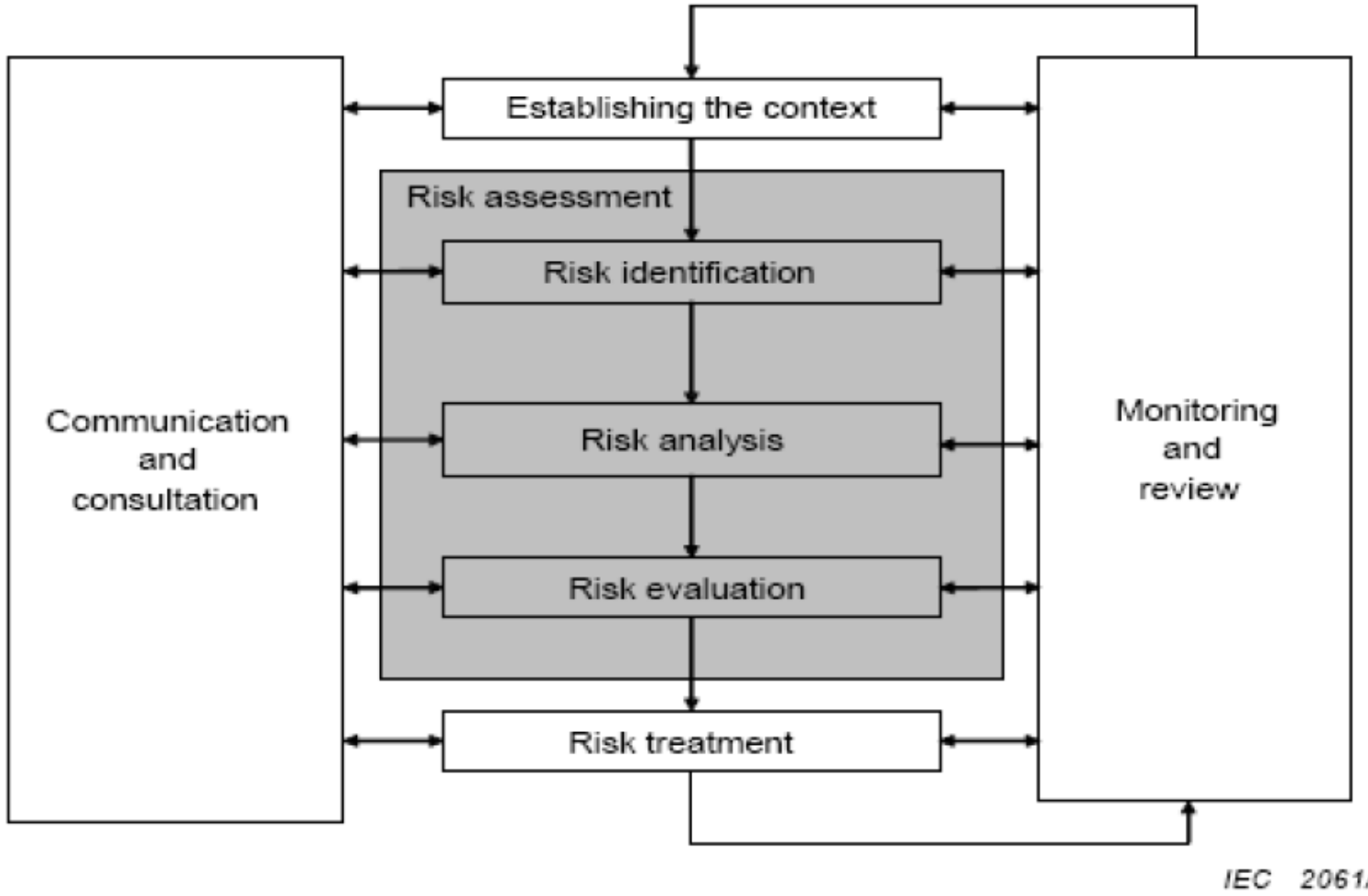



**Figure 1 – Contribution of Risk Assessment to the Risk Management Process**

# What is Acceptable Risk?

- First step in “acceptance” is knowing full extent of risk.
- Acceptability varies depending on “inherent risk”
    - A moving floor would be unacceptable in a restaurant but expected on a fishing vessel.
- People tend to resist risks that are imposed on them rather than those they chose.
    - Noise in the workplace vs playing in a rock band
- Beware “normalization” of risk.
- The level of loss a society or community considers acceptable given existing social, economic, legal, political, cultural, technical and environmental conditions.

# Risk Analysis Matrix

| RISK ASSESSMENT MATRIX | | | | |
|---|---|---|---|---|
| SEVERITY / PROBABILITY | Catastrophic (1) | Critical (2) | Marginal (3) | Negligible (4) |
| Frequent (A) | High | High | Serious | Medium |
| Probable (B) | High | High | Serious | Medium |
| Occasional (C) | High | Serious | Medium | Low |
| Remote (D) | Serious | Medium | Medium | Low |
| Improbable (E) | Medium | Medium | Medium | Low |
| Eliminated (F) | Eliminated | | | |

ANSI/AIHA Z10–2005

**Example of a Risk Assessment Matrix**

| | Severity of Injury or Illness Consequence and Remedial Action | | | |
|---|---|---|---|---|
| **Likelihood of OCCURRENCE or EXPOSURE** For selected Unit of Time or Activity | **CATASTROPHIC** Death or permanent total disability | **CRITICAL** Disability in excess of 3 months | **MARGINAL** Minor injury, lost workday accident | **NEGLIGIBLE** First Aid or Minor Medical Treatment |
| **Frequent** Likely to Occur Repeatedly | **HIGH** Operation not permissible | **HIGH** Operation not permissible | **SERIOUS** High Priority Remedial action | **MEDIUM** Take Remedial action at appropriate time |
| **Probable** Likely to occur several times | **HIGH** Operation not permissible | **HIGH** Operation not permissible | **SERIOUS** High Priority Remedial action | **MEDIUM** Take Remedial action at appropriate time |
| **Occasional** Likely to occur sometime | **HIGH** Operation not permissible | **SERIOUS** High Priority Remedial action | **MEDIUM** Take Remedial action at appropriate time | **LOW** Risk Acceptable: Remedial Action Discretionary |
| **Remote** Not likely to occur | **SERIOUS** High Priority Remedial action | **MEDIUM** Take Remedial action at appropriate time | **MEDIUM** Take Remedial action at appropriate time | **LOW** Risk Acceptable: Remedial Action Discretionary |
| **Improbable** Very unlikely — may assume exposure will not happen | **MEDIUM** Take Remedial action at appropriate time | **LOW** Risk Acceptable: Remedial Action Discretionary | **LOW** Risk Acceptable: Remedial Action Discretionary | **LOW** Risk Acceptable: Remedial Action Discretionary |

# Acceptable/Tolerable Risk
# ALARP - as low as reasonably practicable

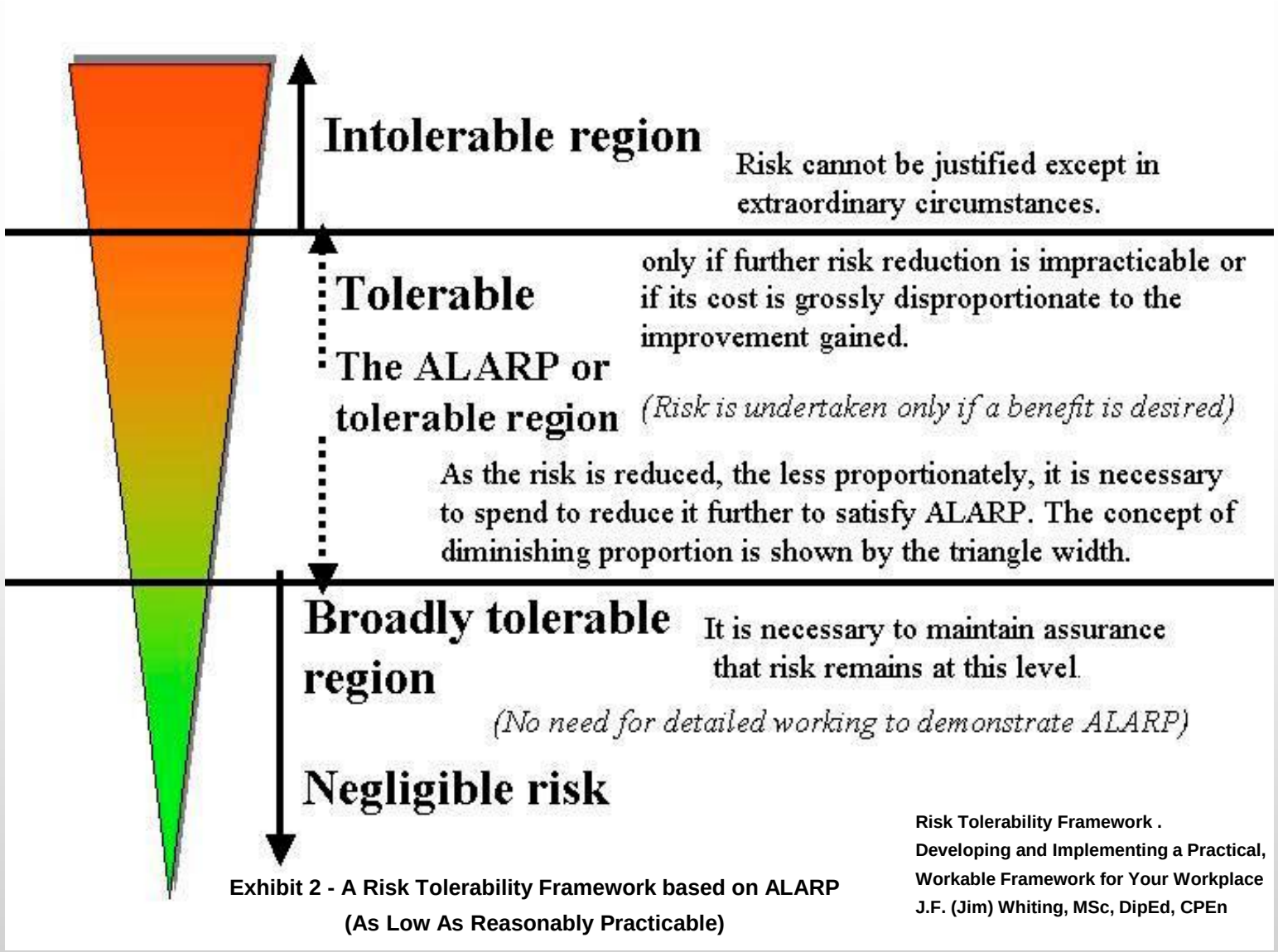



**Exhibit 2 - A Risk Tolerability Framework based on ALARP**
**(As Low As Reasonably Practicable)**

**Risk Tolerability Framework .**
**Developing and Implementing a Practical, Workable Framework for Your Workplace**
**J.F. (Jim) Whiting, MSc, DipEd, CPEn**

# Risk vs Loss-Based Systems - Moving Forward

- Developing proactive, forward thinking, risk based programs and metrics.
- Take the best of what we have used in the past pull them all into a Risk-Based Safety System:
    - Compliance
    - Lagging Indicators/Metrics
    - Behavioral
    - Safety Climate/Culture

    - Risk Reduction
    - Leading Indicators/Metrics
    - Systems Based Assessments and Control Development

- The following slides will provide some examples of practical application of risk-based thinking:
    - Establishing Leading Indicators based on Risk Reduction.
    - Quantifying Risk Reduction
    - Risk-Based Skill Development
    - Prevention through Design
    - Serious Incidents and Fatalities
    - Emerging Risks

Example

# Risk Based Performance Objectives

- Combination of risk reduction objectives, activity objectives and lagging indicators.
  - Word of caution with activity-based or transactional objectives - will they lead us to where we want to go?
- Long range planning (5 years).
- Developing a risk based culture and vocabulary.
- Risk reduction metrics align better with corporate success objectives. Lagging indicators are a measure of harm not safety.

Process Examples

**Ergonomics**
- Initial assessment.
- High/Moderate risk evaluated by quantitative measure
- High/Moderate risks reduced
- Track results

**Industrial Hygiene**
- Quality Risk Assessment
- Reduce High and moderate exposures
- Track results

**5 Year Corporate Health and Safety Goals**

**Injury Drivers**
- 50% Reduction in Ergonomic Risks
- Slip, Trip, Fall Assessments at 50 Sites

**Serious Injury and Fatality Potential**
- Occupational Health Risks Reduced by 95%
- Risk Heat Maps Developed at 50 Sites

**Culture**
- Achieve OSHA Voluntary Protection Program (VPP) at 50 sites.
- Increase Off-the-Job Safety Communications 20%

**OSHA Incident Rates**
- Reduce Recordable Injury Rate $\leq$ 0.49
- Reduce/Maintain DART Injury Rate $\leq$ 0.21
- Achieve/Maintain Lost Workday Injury Rate $\leq$ 0.14

Example

# Tying Risk Reduction to Other Organizational Objectives


https://www.rtx.com/-/media/project/united-technologies/utc/files/2018_utc_cr-report_final.pdf?rev=c1cd58d51d144d21b88a880b765ad2b8&hash=CF250D5EED33CFD828737A95F7F41FF2

# Risk-Based Metrics - Identifying Hazards, Assessing Risk and Quantifying Risk Reduction

## Manufacturer of Paper Food Containers – Residual Risk Reduction

**Table 1**

### Case Study: Baseline Assessment

| Concern | Existing Controls | F | L | S | Risk Score |
|---|---|---|---|---|---|
| Head injury: Fall from elevation | Minimal informal training | 3 | 3 | 5 | 45 |
| Various injury: Struck by, using pry bar | Fall protection available, but impractical and inadequate | 3 | 3 | 3 | 27 |
| Head injury: Struck by, falling pry bar | Cage on crane | 3 | 2 | 5 | 30 |
| Torso injury: Caught between load and rack | | 3 | 3 | 3 | 27 |
| Muscle strain: Using pry bar | | 3 | 4 | 3 | 36 |
| Extremities fracture: Fall between racks | | 3 | 3 | 3 | 27 |
| Electric shock: Contact with ASRS circuits | | 3 | 1 | 5 | 15 |
| Extremities injury: Fall from ASRS unit while traveling | Harness provided but not used consistently | 3 | 4 | 5 | 60 |
| Torso injury: Caught in machine pinch point, automatic motion | Procedure to place crane in manual mode | 3 | 2 | 3 | 18 |
| Pedestrians in aisle struck by falling skids | Gate locked, sensor cable to detect full bins, no items stored in aisles | 3 | 1 | 4 | 12 |
| Head injury: Falling object, hoist chain failure | | 3 | 3 | 5 | 45 |
| | | Risk Index | | | 342 |

**Table 2**

### Case Study: Subsequent Assessment

| Concern | New Controls | F | L | S | Risk Score |
|---|---|---|---|---|---|
| Head injury: Fall from elevation | Update proximity sensors to increase sensitivity | 2 | 2 | 3 | 12 |
| Various injury: Struck by, using pry bar | Conduct daily test of the system | 2 | 3 | 3 | 18 |
| Head injury: Struck by, falling pry bar | Repair and realign racks | 2 | 1 | 3 | 6 |
| Torso injury: Caught between load and rack | Secure pry bars with rope | 2 | 2 | 3 | 12 |
| Muscle strain: Using pry bar | "Square-up" loads on skid before placement on ASRS picking station | 2 | 2 | 3 | 12 |
| Extremities fracture: Fall between racks | Provide solid cover over operators' platform | 2 | 1 | 2 | 4 |
| Electric shock: Contact with ASRS circuits | Consult with fall protection equipment supplier on integrated fall arrest system | 2 | 1 | 5 | 10 |
| Extremities injury: Fall from ASRS unit while traveling | Jam-clearing procedures written and audited | 2 | 2 | 3 | 12 |
| Torso injury: Caught in machine pinch point, automatic motion | Train and certify technicians | 2 | 2 | 3 | 12 |
| Pedestrians in aisle struck by falling skids | Use an observer when a technician is in the rack | 2 | 1 | 4 | 8 |
| Head injury: Falling object, hoist chain failure | Provide a clutch brake on the ASRS platform | 2 | 1 | 5 | 10 |
| | | Risk Index | | | 116 |

66% Reduction in Risk for Assessed Tasks

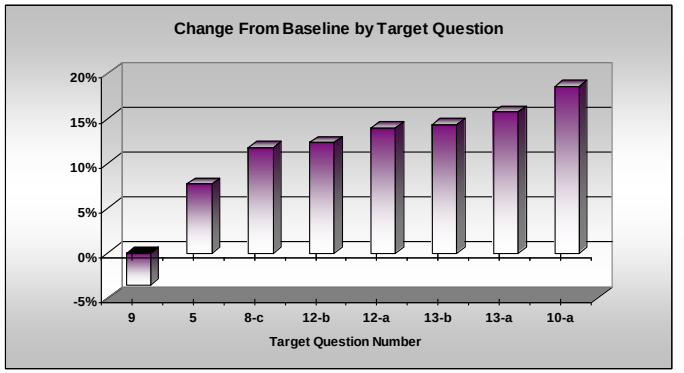
Tolbert, Professional Safety Nov. 2005

Example

# Focus on Risk Reduction – Skills vs Training

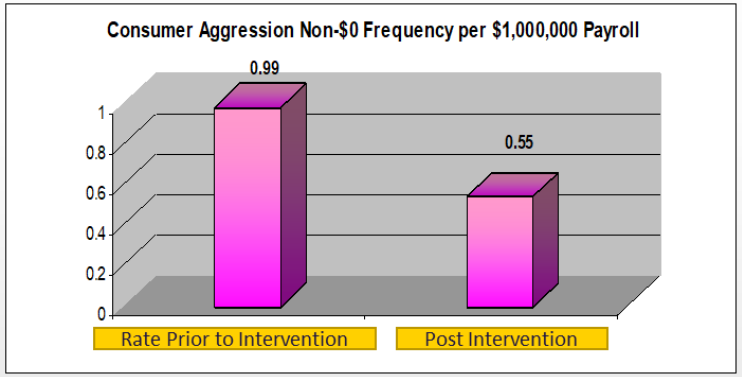
Social Service Agency

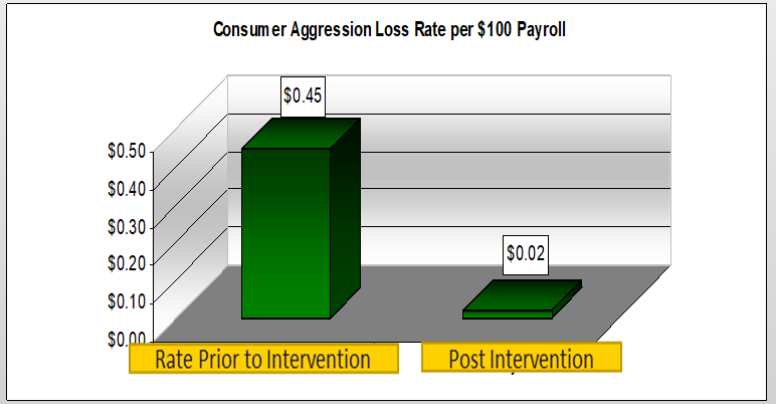
- Worker injuries that result from behavioral interactions with consumers have been prevalent within the organization.
- One of the primary/required controls to reduce consumer aggression is Psychological Management Training (PMT) and Strategies for Crisis Intervention and Prevention (SCIP).
- Assessed retention of key points though a tailored survey based upon fundamentals taught during PMT.
- Participants
  - 214 direct care staff at 27 locations
- Targeted interventions aimed at improving retention of low scoring questions
- We hypothesized that there would be an overall increase during the second phase of the analysis, directly correlating to the increased staff education opportunities.
  - There would be an increase in total assessment scores from baseline
  - There would be an increase in Target Questions scores from the baseline of focused initiatives in these areas




Targeted interventions improved retention of key points

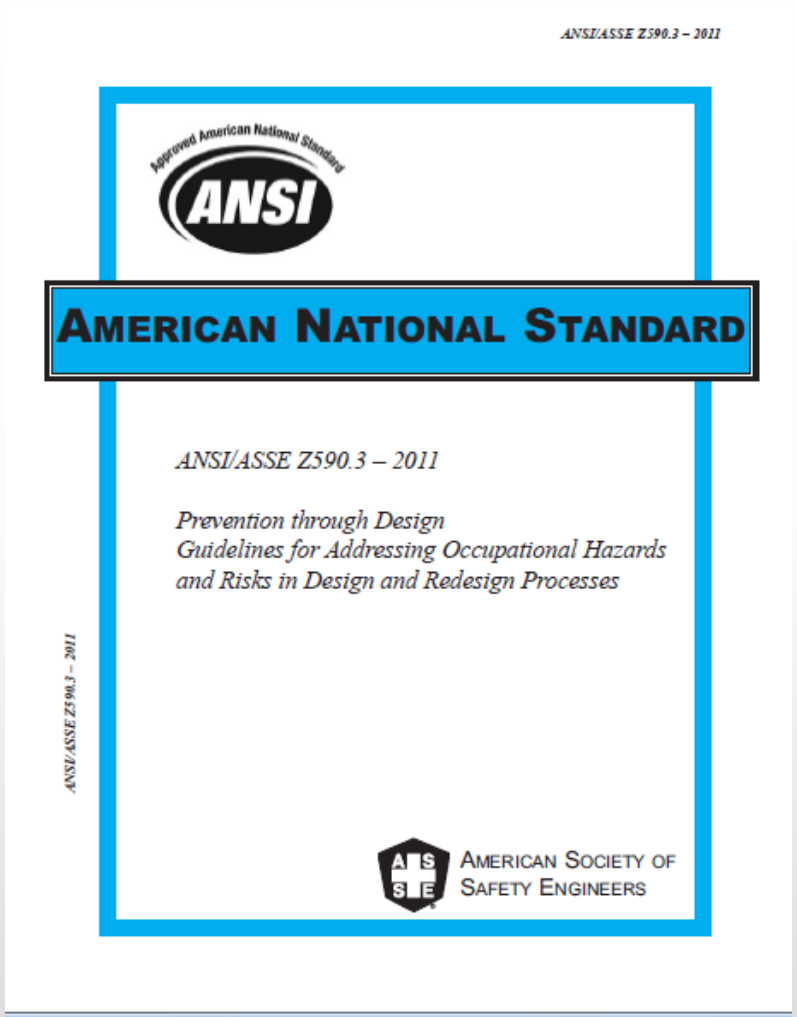
Resulting in fewer injuries




Resulting in significant cost savings!

# Prevention through Design (PtD) - What Is It




- This standard provides guidance on including prevention through design concepts within an occupational safety and health management system.
- Through the application of these concepts, decisions pertaining to occupational hazards and risks can be incorporated into the process of design and redesign of work premises, tools, equipment, machinery, substances, and work processes including their construction, manufacture, use, maintenance, and ultimate disposal or reuse.
- This standard provides guidance for a life-cycle assessment and design model that balances environmental and occupational safety and health goals over the life span of a facility, process, or product

STOP Chasing Losses and Address RISK

# What Does It Do For Us?

- Address Risk At The Design Stage, leading to:
  - Increased productivity and quality – Those who work in the space.
  - Strengthened designer- builder collaboration – Those who build the space
  - Improved operations/maintenance safety – Those who work on the space
  - Improved Customer Experience
  - Ultimately - Employee/Guest Loss Reduction
- Standardize “Safe” Design Features
  - Can Be Developed As New Information is Gained
- Brings All Key Stakeholders Together

Example

# Prevention through Design in Practice

**Large Corporate Office**

- Several years of education and prep on PtD for EHS, designers and facility managers.
  - Smaller projects
  - Build expertise, experience and credibility
- Seized on the opportunity early, when designs/drawings began.
- Included Architects, Designers, the GC, Construction Consultants, Corporate Real Estate, Risk Management, Safety and the insurance company.
- Regular design review meetings were held and design alterations tracked. Ex:
  - Assessed almost all hard floor surfaces being placed into the building for slip resistance.
- Design standards began to emerge and were understood by the entire construction team.
- The process was continued during the construction phase where additional improvements were made based on observations as the building was erected.

- Risk Reduction Results:
  - **153 design considerations identified and logged**
  - **85% of recommendations incorporated into design**
- Many changes incurred low or no additional cost.
- Design standards now a core element of review for future projects.

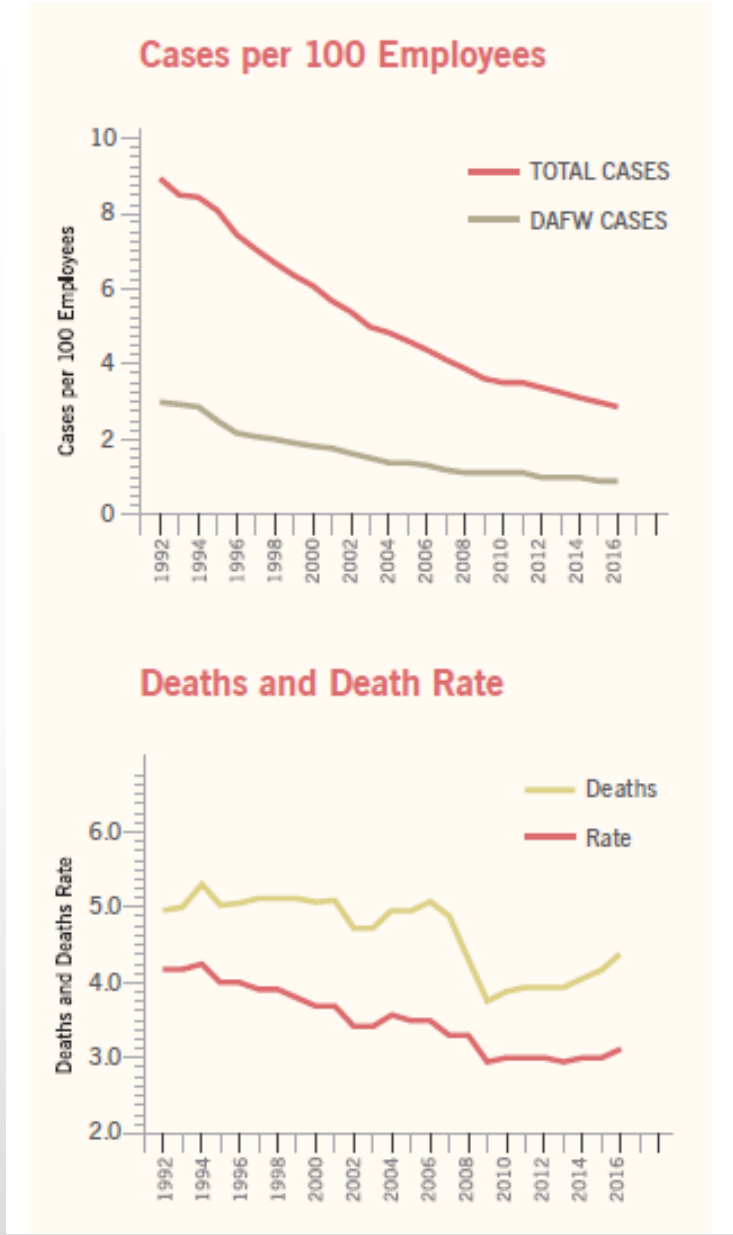
# Serious Incident and Fatality Risk

Problem Statement

- Recordable and lost time injury rates have been on a steady decline within industry for many years, but the fatality rate is flat or increasing in comparison.
- The bottom line – Organizations have spent extensive time and resources on improving safety, however the crucial safety events, serious injuries and fatalities, are not improving.

Evidence Shows

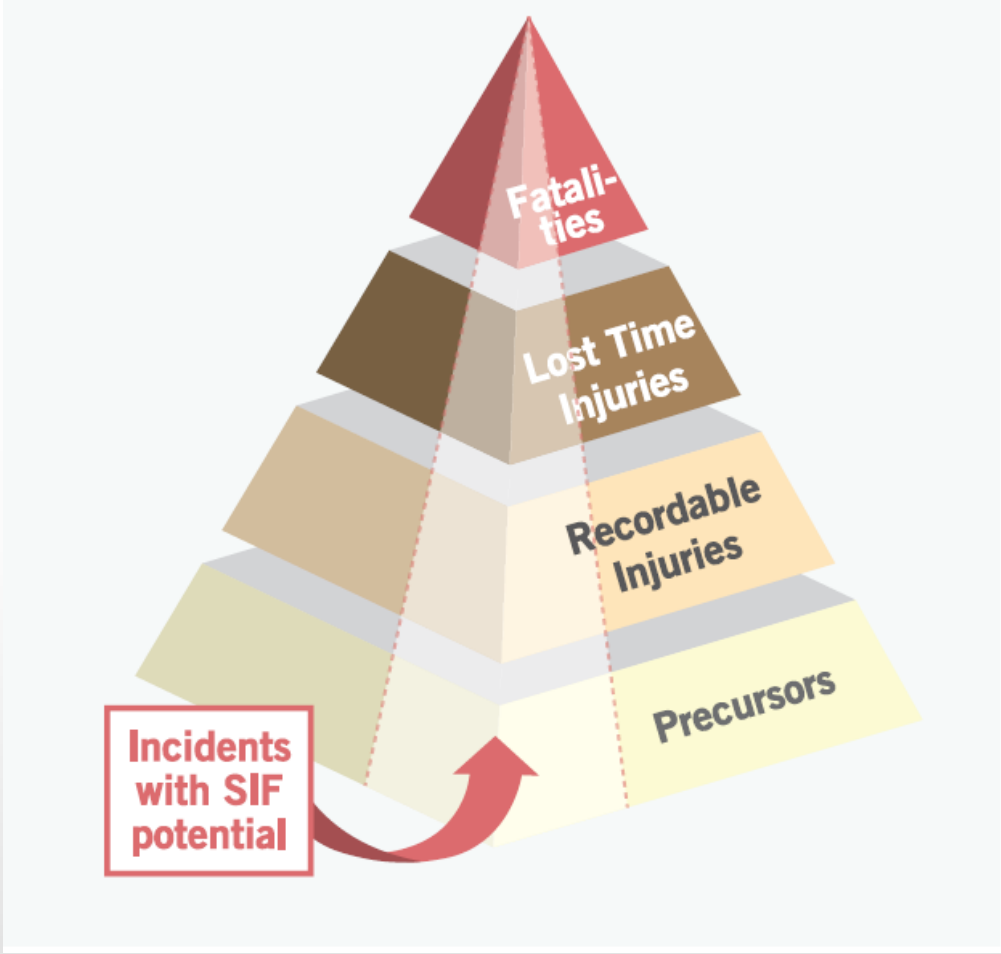
- Severe injury potential:
  - Unique and singular events.
  - Causes are a subset or different than frequency drivers
  - Frequency and severity poorly correlated.
- Severe risk hazard identification:
  - Unusual or non-routine work,
  - Non-production activities,
  - Sources of high energy,
  - Construction situations
- Series of breakdowns. Disruptive event.
- Not meant to divert frequency reduction but add to/broaden the process for risk reduction.




Campbell Institute 2018

# What Does it all Mean? Heinrich theory does not fit.

- Existing safety systems are not reducing SIF events:
  - The traditional safety triangle cannot accurately predict these events (studies reveal approximately 21% of injuries have SIF potential)
  - Reducing incidents at the bottom of the triangle does not correspond to an equivalent reduction of SIF's because not all incidents/injuries have SIF potential



# How do I Identify SIF Potential?

- Who?
  - Accident and Near Miss Data
  - JHA or other task assessments
  - ***Talk to the employees (those closest to the risk)***
  - Include various stakeholders, i.e. Supervisor, Dedicated Maintenance, Operators etc
- What?
  - What are unplanned breakdowns/upsets or non-routine maintenance tasks that occur at this facility?
  - Can you tell me about the process to fix the breakdown/upset?
  - How often does it occur?
  - Do you stop and plan the work, review hazards, etc.?

Example

# Serious Injury Risk –Asphalt Batch Plant

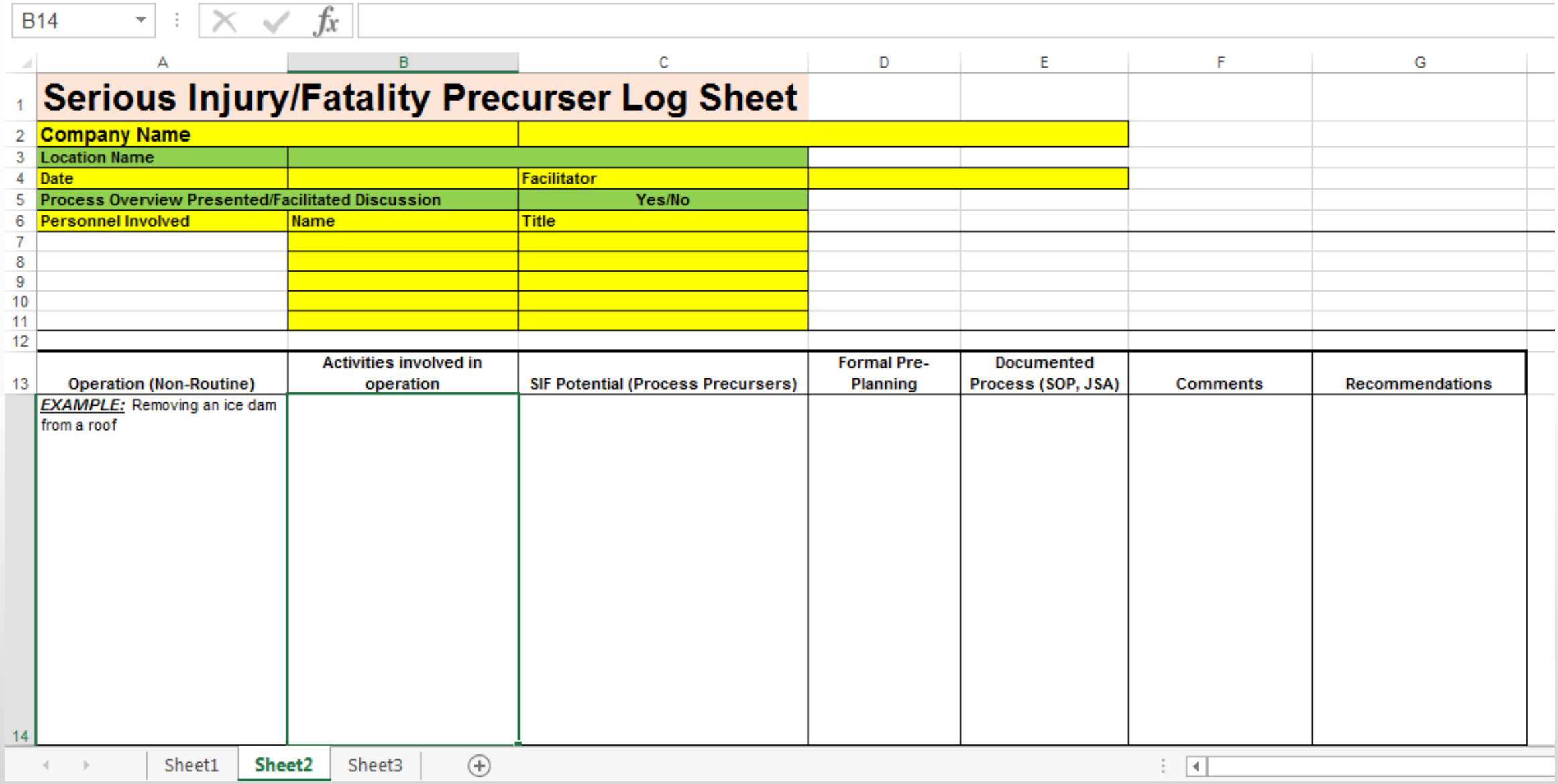
Street and Road Contractor

- Overall positive injury results as compared to industry benchmarks but had periodic serious accident/fatality.
  - Rare not Random
- Batch plant focus due to;
  - few employees,
  - machine and falls exposure and
  - production demands.
- Past losses where not precursors of serious accidents.
- Educated and engaged employees on SIF.
- Developed a tracking form/risk assessment.

Results

- Better informed and educated staff.
- Initial review identified and average of 5 SIF's per plant at 8 similar plants.
- Recommendations (systems level) submitted and tracked.
- Part of ongoing activities.

Compliance-only programs may have missed these!


B14
Serious Injury/Fatality Precurser Log Sheet
Company Name
Location Name
Date
Facilitator
Process Overview Presented/Facilitated Discussion
Yes/No
Personnel Involved
Name
Title
Operation (Non-Routine)
Activities involved in operation
SIF Potential (Process Precursers)
Formal Pre-Planning
Documented Process (SOP, JSA)
Comments
Recommendations
EXAMPLE: Removing an ice dam from a roof
Sheet1
Sheet2
Sheet3

# Emerging/Developing Risks - A Short List

- Covid
  - Biological Risks - Epidemics
- Working at Home
- Changing work patterns
  - Vet Clinics
  - Banks
- Age
- Obesity
- Sedentary Work
- Shiftwork and Fatigue
- Climate Change

**NIOSH Total Worker Health**

- Distracted Driving
- Psychosocial
  - Work Environment
  - Work Design
  - Work/Life Balance
  - Situational Changes
    - Job Insecurity, Technology, Job Control, Workplace Support
- Workplace Violence
- Engineered Nanomaterials

Must move to Risk-Based programs to address these issues – Compliance alone will not do it!

# Conclusion

- The opportunity exists for organizations to drive Risk-Based Safety Systems.
  - Does not mean abandoning the past, just adapting it.
- Many examples out there.
- As much an art as science.
  - Choosing the right goals and metrics
  - Start small and build credibility
- Digs down into the hierarchy of controls to address systems not symptoms.
- Involves those closest to the risk.

# Questions?

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