



NSC Serious Incident & Fatality (SIF) Prevention Model

**NORA Construction Sector Council Meeting
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Acknowledgements

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Disclaimer: The SIF Project is funded by US Steel. The contents of this session reflect the contributions of individual speakers and are solely their responsibility, and do not necessarily represent the views of US Steel.

Who is the National Safety Council?

The National Safety Council is America's leading nonprofit safety advocate – and has been for over 100 years. As a mission-based organization, we focus on eliminating the leading causes of preventable death so people can live their fullest lives. We focus our efforts where we can make the greatest via the [workplace](#) and [roadway](#).

**Save lives, from the
workplace to anyplace.™**

NSC Networks

- **Highly specialized communities** where members engage in new ways to achieve and maintain superior health, safety and environmental performance
- A respected and influential business voice for HSE policies, regulation and programs, known as an **ethical broker and source for responsible industry positions**
- **A recognized thought leader** in HSE, having spearheaded industry efforts to address key challenges and issues
- Proactive positive impacts on the development of **global HSE policies, standards and practices.**



NSC Networks



Occupational Safety & Health Network

Executive Business Issues Forum

Corporate Health Directors Network

Western Occupational Safety & Health Network

Legal Issues Network

Global Health, Safety & Environment Forum

European Health, Safety & Environment Forum

Asia Pacific Health, Safety & Environment Forum

Background on SIF Prevention Model

- The NSC SIF Prevention Model is a conceptual tool designed to help organizations better understand and analyze serious safety threats.
- This model is built around the Plan-Do-Check-Act (PDCA) continuous improvement framework and is aimed at prevention.
- Key principles of Human and Organizational Performance (HOP) are integrated into the risk assessment model, considering the impact of systems, culture, and human behavior on SIF prevention.

Definitions – SIF

- **SIF: Serious Incident or Fatality**
 - Cases or incidents that are considered life threatening, life altering, or a workplace related death.
 - An incident in the workplace under this model includes: Serious injuries and illnesses, fatality, environmental issues, workplace fires and explosions, and significant property damage.

Definitions - pSIF

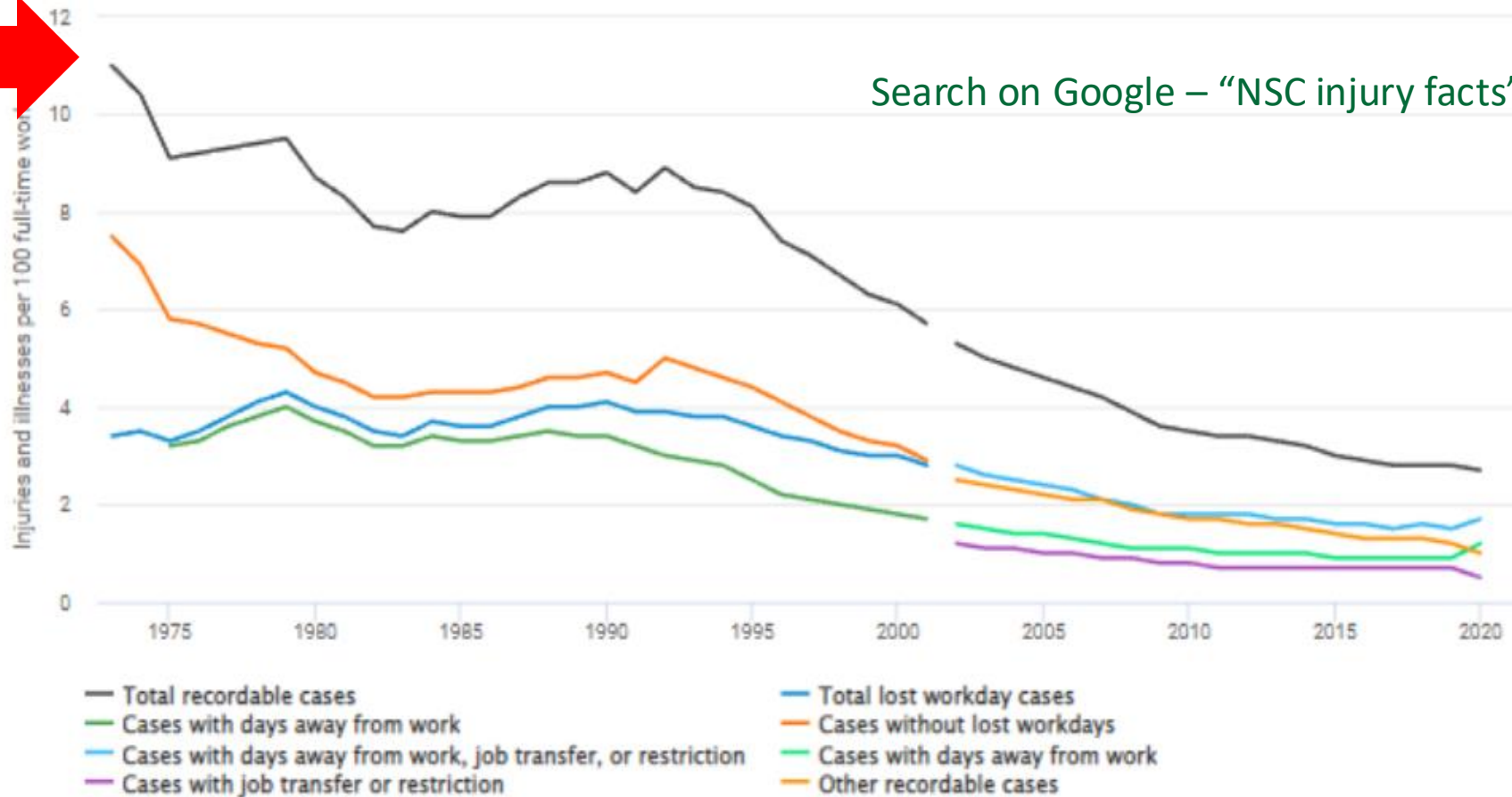
- **pSIF (potential SIFs)**
 - Incidents that have the potential to have resulted in a serious injury/illness or fatality due to the pre-cursors or sources of energy involved e.g., work at heights, electrical, rigging, lifting, machine intervention, etc.
 - **Often includes near misses**

Macro View – Progress Over Time

OSHA
Total
Recordable
Cases



Work-related-injury and illness incidence rates, private industry, United States, 1973-2020

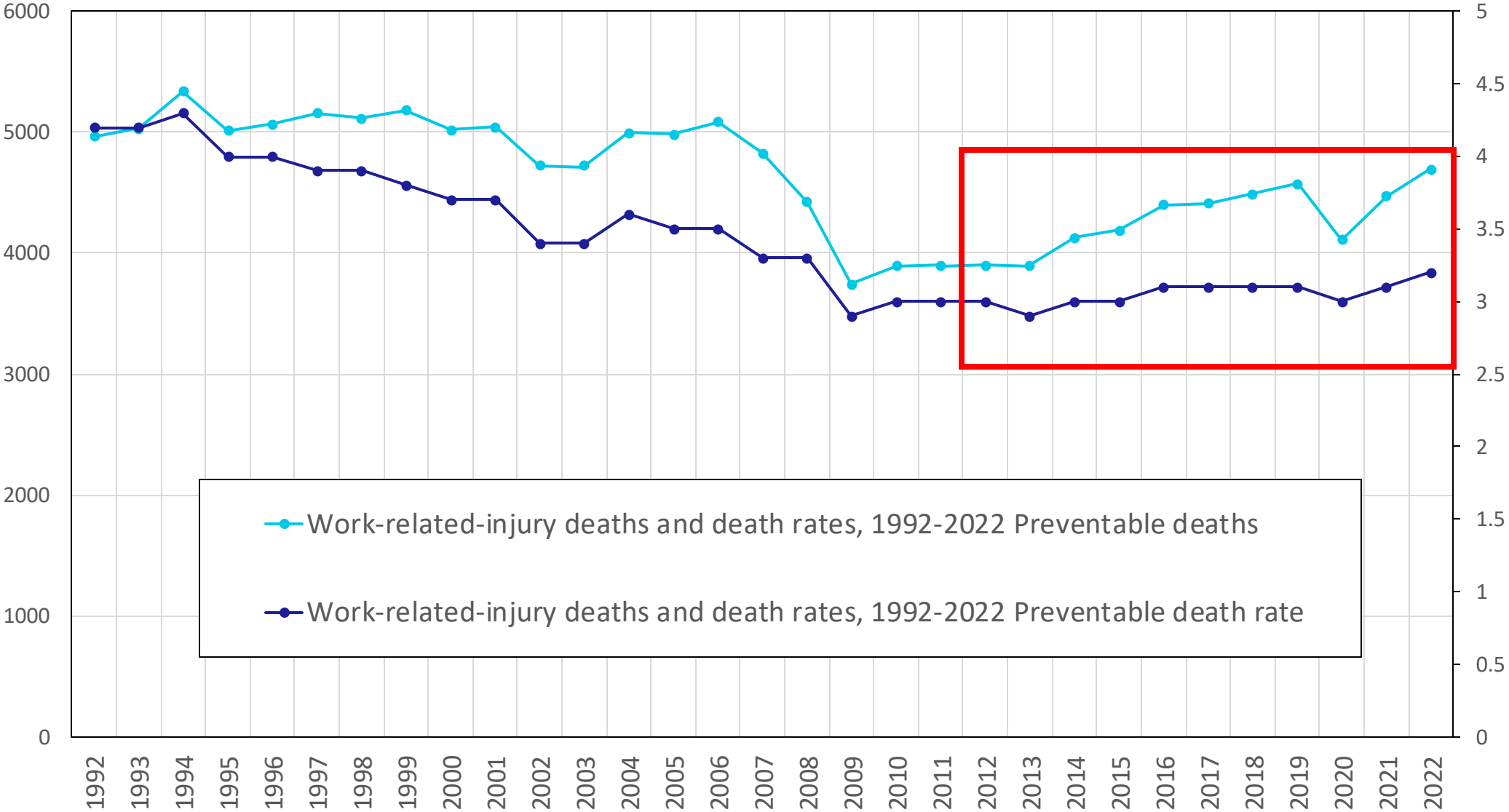


Why is a SIF Prevention Model Needed?

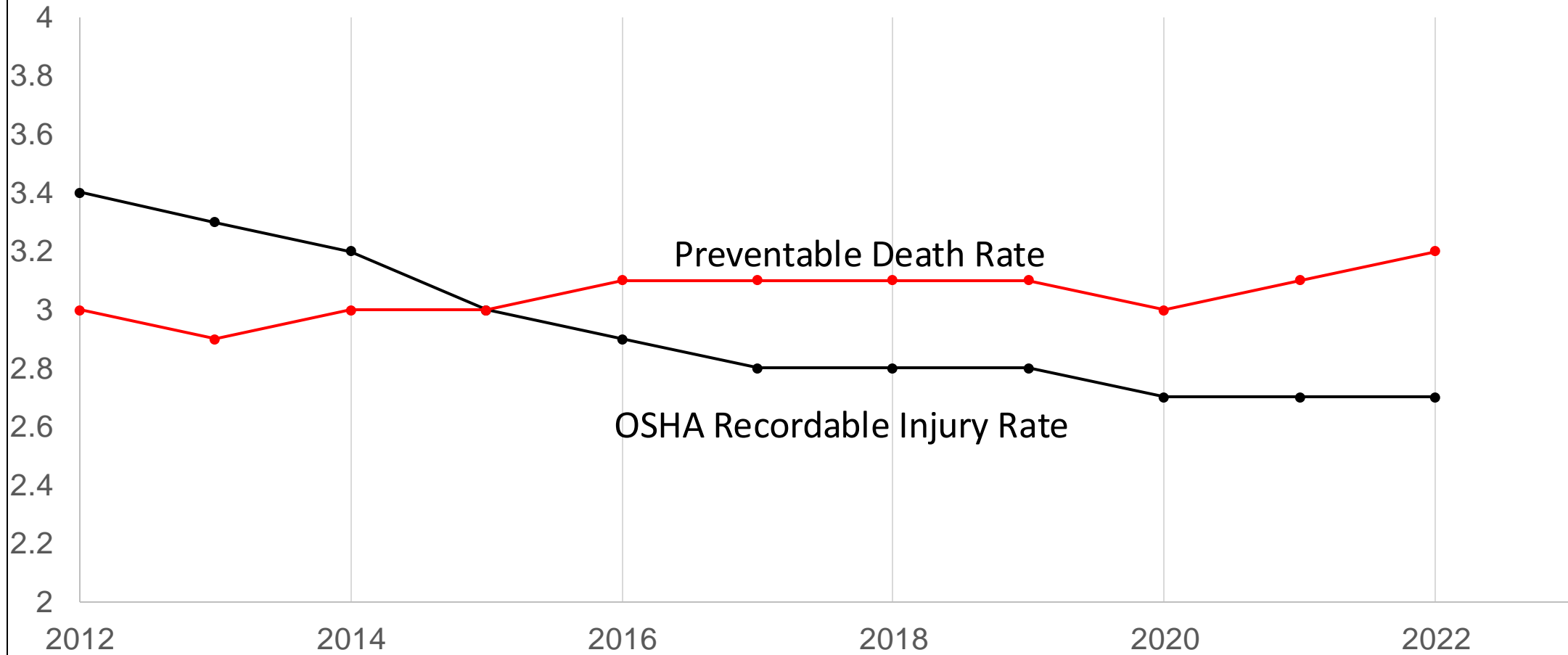
More than **5,000 fatalities occur annually in U.S. workplaces**, highlighting a critical need for more effective preventative measures and systems.

Bureau of Labor Statistics. (2024). Retrieved from www.bls.gov

Work-related-injury deaths, death rates, 1992-2022



US Total Recordable Rate (per 100 workers) US Fatality Rate (per 100,000 workers)

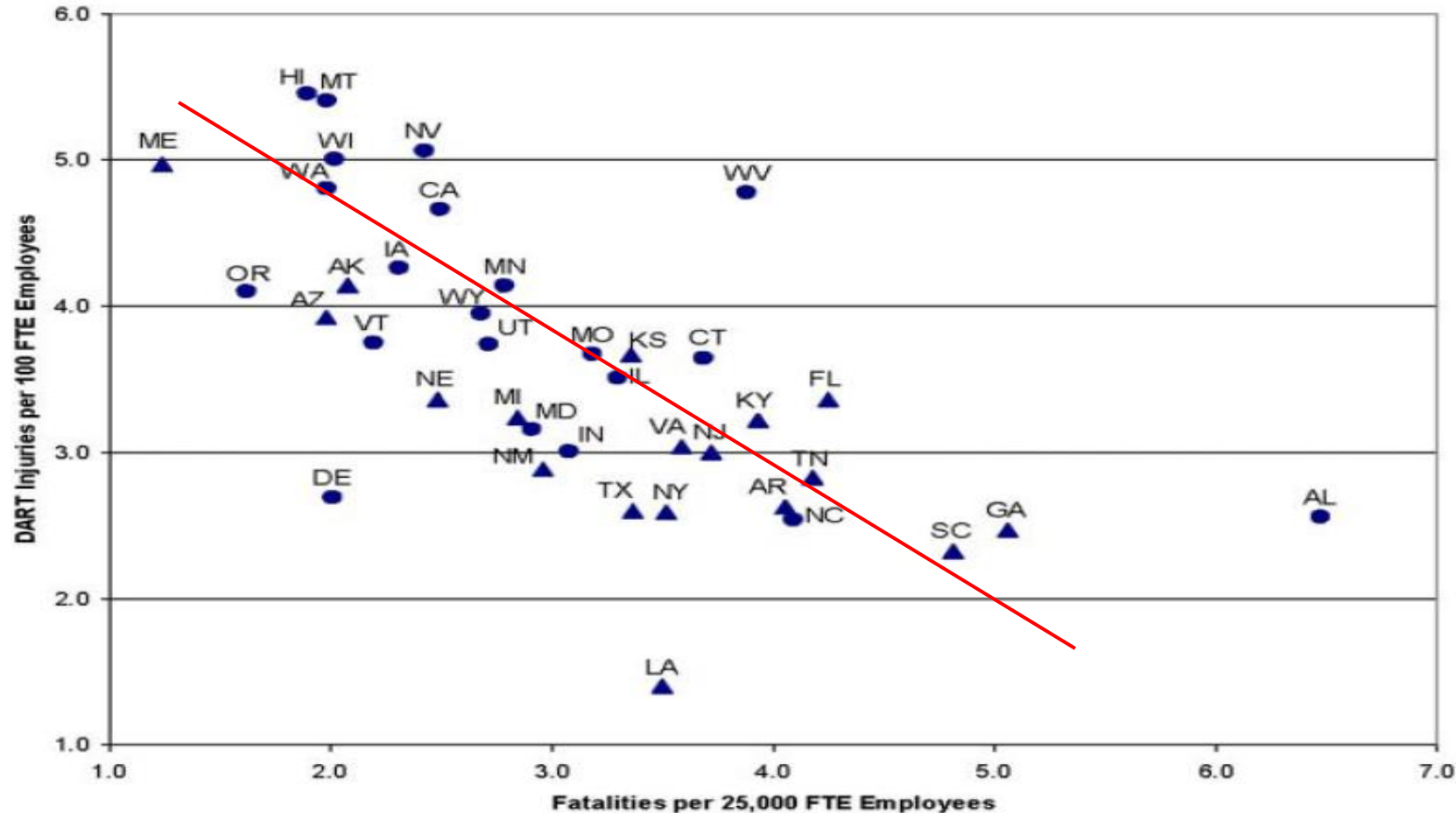


—●— Work-related-injury and illness incidence rates, private industry, United States, 1973-2022 Total recordable case rate (per 100 full time workers)

—●— Work-related-injury and illness incidence rates, private industry, United States, 1973-2022 Preventable death rate (per 100,000 workers)

Is the Heinrich Pyramid correct?

The lower the incident rate, the higher the fatality rate? ...Not useful for SIFs anymore



- State DART rate vs. fatalities graphic
 - 2013 RAND Study Am J Ind Med
- Corroborating Studies
 - Finnish Construction and manufacturing study 1977-1991
 - Aviation passenger mortality risk 2000
 - Occupational Injury Statistics in Korea 2011
 - Injury rate 1/5 EU rate
 - fatality rate 5 x's EU's

“Disasters don’t happen because someone drops a pipe on his foot or bumps his head. They result from flawed ways of doing business that allow risks to accumulate.”

(Elkind and Whitford 2011, p. 7)

The Statistical Invalidity of TRIR as a Measure of Safety Performance

*Dr. Matthew Hallowell, Mike Quashne,
Dr. Rico Salas, Dr. Matt Jones, Brad MacLean,
Ellen Quinn*

November 2020

Parametric and non-parametric statistical analysis data revealed that:

01.

There is no discernible association between Total Recordable Incident Rate (TRIR) and fatalities;

02.

The occurrence of recordable injuries is almost entirely random;

03.

TRIR is not precise and should not be communicated to multiple decimal points of precision; and

04.

In nearly every practical circumstance, it is statistically invalid to use TRIR to compare companies, business units, projects, or teams.

The Things That Hurt People Are Not the Same as the Things That Kill People: Key Differences in the Proximal Causes of Low- and High-Severity Construction Injuries (ascelibrary.org)



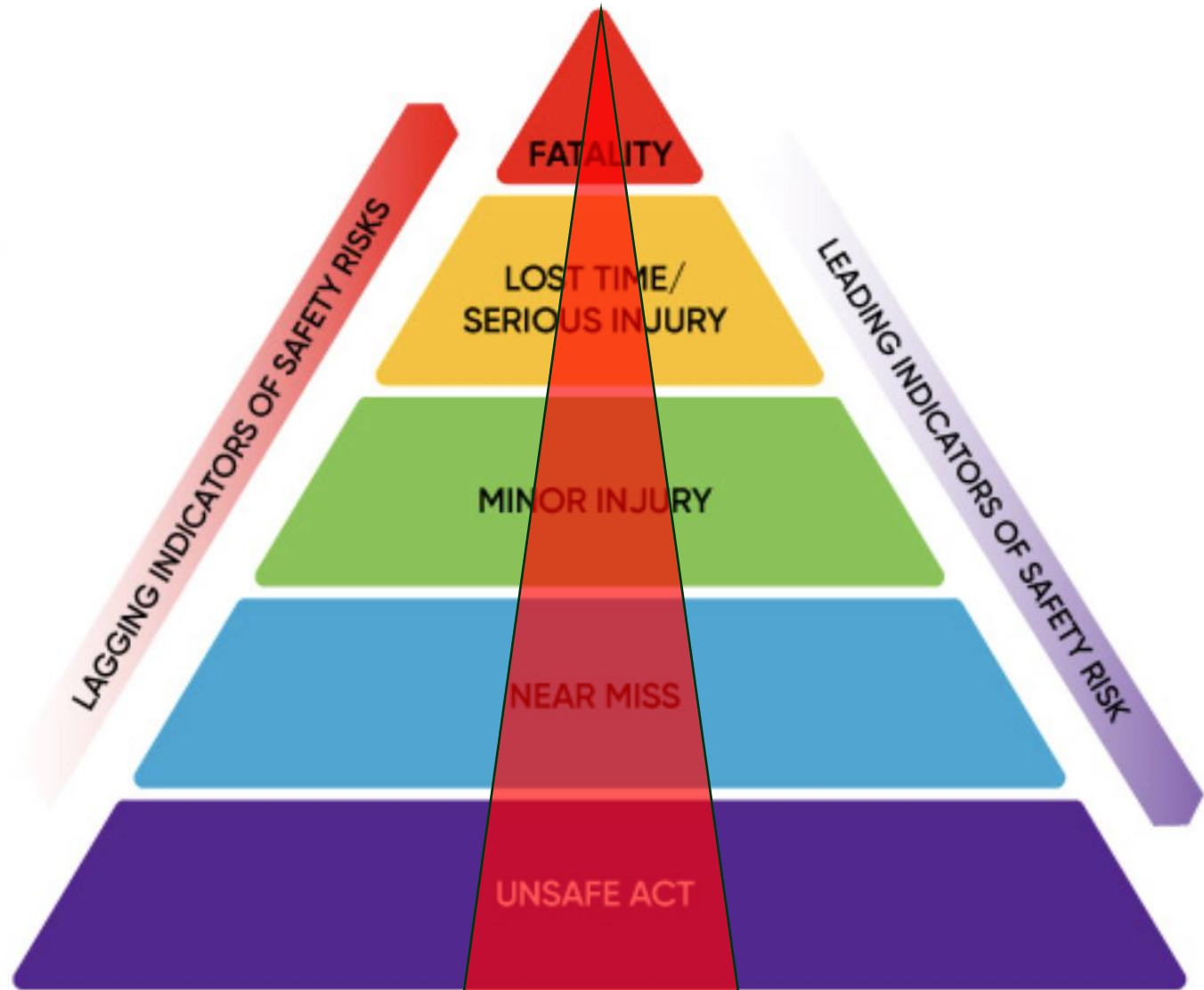
ASCE

The Things That Hurt People Are Not the Same as the Things That Kill People: Key Differences in the Proximal Causes of Low- and High-Severity Construction Injuries

Arnaldo Bayona, S.M.ASCE¹; Matthew R. Hallowell, A.M.ASCE²;
and Siddharth Bhandari, A.M.ASCE³

Abstract: The safety profession has been shaped by the assumption that there is a fixed ratio of low- to high-severity injuries and the notion that injuries of all severity levels share the same general causes. There is now very strong empirical evidence that this ratio is not fixed, which has led to a new hypothesis that serious injuries and fatalities (SIFs) happen for different reasons than lower-severity injuries and the idea that a targeted approach is needed for SIF prevention. To better understand this phenomenon, this study explored the question: *what, if anything, is different about the causes of SIFs?* To answer this question, a research team of construction safety experts and academics hypothesized seven factors that may be unique to high-severity injuries. Concurrently, details of serious injuries and fatalities (SIF, $n = 13$), potential serious injuries and fatalities (PSIF, $n = 12$), and low-severity injuries (LSI, $n = 13$) were collected from utility, oil and gas, commercial, pipeline, and specialized construction trades. Blind to each injury outcome, the team assessed the presence or absence of the seven potential differentiators. The samples were then compared using Fisher's exact test to determine if any factors explained the differences among the injury types. Although there were no differences between SIF and PSIF cases, two factors differentiated LSI and PSIF/SIF: (1) absent direct controls; and (2) absent or not followed work plan. Surprisingly, no human factors were significant. The results indicate that the control of high-energy hazards through effective work planning, discipline, and execution is vital for targeting SIFs, supporting the theory that a differentiated approach is needed to avoid the concerning plateau in the rate of construction fatal injuries. DOI: [10.1061/JCEMD4.COENG-14545](https://doi.org/10.1061/JCEMD4.COENG-14545). This work is made available under the terms of the Creative Commons Attribution 4.0 International license, <https://creativecommons.org/licenses/by/4.0/>.

Heinrich's Triangle Theory



Heinrich's Triangle Theory

High Hazard Activities

- Mechanical Energy / Machine Guarding
- Confined Space Entry
- High Pressure
- Suspended Loads
- Engulfment Hazards
- Extreme Temperature Environment
- Powered Industrial Vehicles
- Driving Motor Vehicles
- Work at Height
- Toxic or Reactive Chemicals
- Flammable / Explosive Materials
- Electrical (Contact or Arc Flash)
- Non-routine Maintenance
- High Temperature Equipment / Processes
- Biological Hazards
- Radiation
- Air and Water Transportation

What is the NSC SIF Prevention Model?

The Model provides a structured, system-based approach to understanding and mitigating hazards and risks that lead to serious incidents and fatalities.

NSC's SIF Prevention Model



Key Aspects of the SIF Prevention Model

1. **Proactive Risk Management:** The Model promotes a proactive approach to mitigate risks before they lead to serious incidents.
2. **Systems and Risk-Based Approach:** Provides a comprehensive understanding of how different systems interact within an organization
3. **Comprehensive Safety Framework:** By integrating both behavioral and technical aspects of safety, the SIF Model offers a more complete view of workplace safety challenges, facilitating more effective and sustainable solutions.

SIF Prevention Model Framework – PDCA

PLAN - Assess Organizational Attributes Related to SIF and Prepare the Organization for the Upcoming SIF Prevention Work

DO – Identify Potential SIF Threats, Assess Risks, and Implement Needed Defenses/Controls

CHECK – Verify Defenses/Controls Are Working Properly and Monitor Over Time

ACT – Drive Continuous Improvement in SIF Prevention Programs and Strategies

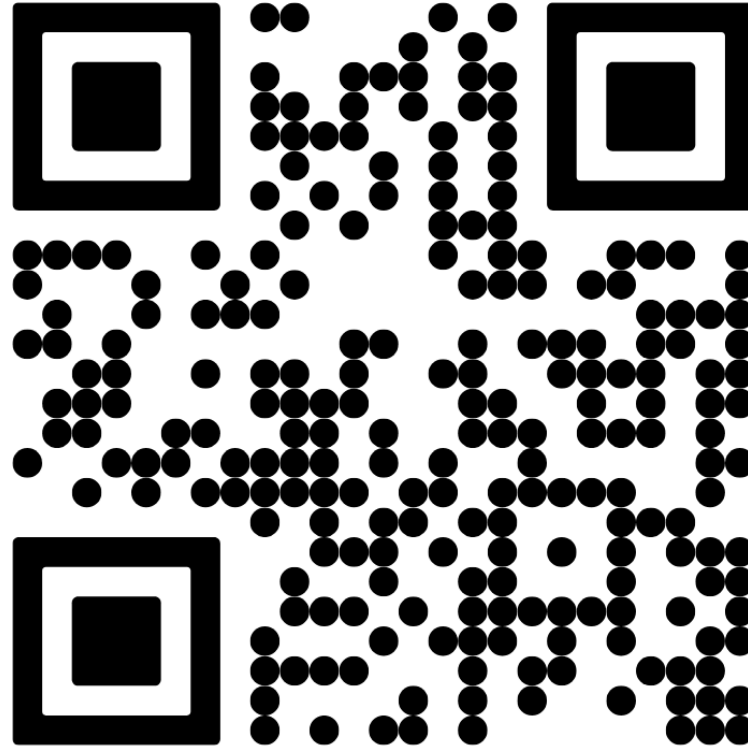


6-Steps in the SIF Model

There are 6 Steps we will work through in implementing the Plan-Do-Check-Act sections of the model :

- **Step 1:** Assess existing organizational capacity for SIF prevention and preparing organization for SIF prevention work
- **Step 2:** Conduct initial hazard identification and determine the risk
- **Step 3:** Implement additional defenses/controls where needed
- **Step 4:** Verify that defenses/controls are sufficient and working properly
- **Step 5:** Monitor defenses and controls over time
- **Step 6:** Fill SIF-related management system gaps and build infrastructure for continuous improvement.

NSC SIF Prevention Model



<https://www.nsc.org/workplace/sif>



HOME / WORKPLACE SAFETY

Serious Incident and Fatality (SIF) Prevention Model

Helping employers identify SIF hazards, implement and verify controls and provide continuous control monitoring.



Plan: Leadership Commitment and Organizational Readiness
Step 1. Assess existing organizational capacity for SIF prevention and prepare organization for SIF prevention work.

Do: SIF Risk Understanding
Step 2. Conduct initial hazard identification and determine the risk
Step 3. Implement additional defenses/controls where needed

Check: Control Analysis and Verification
Step 4. Verify that defenses/controls are sufficient and working properly
Step 5. Monitor defenses and controls over time

Act: Continuous Improvement
Step 6. Drive continuous improvement in SIF prevention programs and strategies

About this Model

HOME / WORKPLACE SAFETY / SIF PREVENTION MODEL

PLAN - Leadership Commitment and Organizational Readiness

PLAN

DO

CHECK

ACT

Step 1: Effective prevention of SIF requires thorough planning and preparation. Identifying and comprehending organizational strengths and weaknesses concerning SIF, involving key stakeholders (workers), and securing leadership support are crucial steps in the process.

The PLAN stage of this model contains four tools designed to complement each other.

Initial Documentation Review

This tool lists key organizational documents related to worker protection and SIF prevention that should be reviewed for accuracy and may be needed as the model is reviewed and implemented.

[Tool 1>](#)

SIF-related Organizational Gap Analysis

Identify and assess key elements to SIF prevention, including management commitment and worker involvement.

[Tool 2>](#)

SIF-related Safety & Health Perception Survey

Confidential, blinded surveys promote candor and provide an unbiased look at the status of worker protection policies, practices and programs.

[Tool 3>](#)

Key Stakeholder Discussion Points

Discussion points to guide interviews and get a better understanding of SIF risks. Includes criteria for leadership to ensure engagement and buy-in from the top and examples for worker engagement.

[Tool 4>](#)

Step 1: Plan – Tools 1-4

Step 1: Effective prevention of SIF requires thorough planning and preparation. Identifying and comprehending organizational strengths and weaknesses concerning SIF, involving key stakeholders (workers), and securing leadership support are crucial steps in the process.

- Tool 1: List of suggested documents to review
- Tool 2: Org Gap Analysis
- Tool 3: Perception Survey
- Tool 4: Key Stakeholder Interview Questions

DO - SIF Risk Understanding

[PLAN](#)[DO](#)[CHECK](#)[ACT](#)

The **DO** section of this model contains Step 2 and Step 3 for identifying potential SIF threats, assessing risk, and implementing needed controls. To get the most out of this model, complete the assessment in Step 2 then apply the information in Step 3.

Step 2. Conduct a General Site Assessment and Determine the Risk Factors

Conduct a general site assessment and determine the risk factors that are applicable to all employers, regardless of their size and regardless of the level and strength of their safety and health management system or program. The general site assessment provides employers a determination of their hazards, level of risk, and the strength of existing controls.

[Start Assessment \(.pdf\)](#)

Step 3: Identify Hazards and Implement Defenses or Controls

Using the elements and criteria from the general site assessment (Step 2), create a baseline for the site/organization's safety and health "status" and begin the process of evaluating and classifying all the potential SIF hazards with these four tools.

Identification of Potential SIF High Hazards

This tool provides guidance in identifying the most critical hazards examples are provided below.

[Tool 5 \(.pdf\)](#)

Learning Teams

Facilitate a discussion among all individuals having knowledge and information about a process, procedure or piece of machinery to properly assess the strength of controls for given hazards.

[Tool 6 \(.pdf\)](#)

Risk Analysis and Strength of Current Controls

Enter your high hazards identified in Tool 5 to determine the level of risk

Determine the Controls - SIF Hazard Control Matrix

Once you have prioritized SIF hazards and evaluated effectiveness of

PLAN

DO

CHECK

ACT

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[Tool 6 \(.pdf\)](#)

Risk Analysis and Strength of Current Controls

Enter your high hazards identified in Tool 5 to determine the level of risk to workers in this tool. You can adjust controls, add controls, or create new controls to lower the level of risk in the next step.

[Tool 7 \(.xlsx\)](#)

Determine the Controls - SIF Hazard Control Matrix

Once you have prioritized SIF hazards and evaluated effectiveness of existing controls, you can determine what additional controls are needed. This tool provides instruction and tables to guide you.

[Tool 8 \(.docx\)](#)

[Continue to Next Step >](#)

Step 2: Do – Understanding the Risks

Step 2. Conduct a General Site Assessment and Determine the Risk Factors

- Conduct a general site assessment and determine the risk factors that are applicable to all employers, regardless of their size and regardless of the level and strength of their safety and health management system or program.
- The general site assessment provides employers a determination of their hazards, level of risk, and the strength of existing controls.

Step 3: Do – Risks & Controls

Step 3. Identify Hazards and Implement Defenses or Controls

Using the elements and criteria from the general site assessment (Step 2), create a baseline for the site/organization's safety and health "status" and begin the process of evaluating and classifying all the potential SIF hazards with these four tools.

- Tool 5: Identifying Potential SIF Hazards
- Tool 6: Learning Teams
- Tool 7: Risk Prioritization Tool
- Tool 8: SIF Hazard Control Matrix

Steps 4–5: Efficacy of Controls



Steps 4 and 5 are critical steps in hazard mitigation. It is not enough to agree on the control measure, implement the control(s), and then assume the work is done and one has successfully controlled the hazard. The controls must be verified to ensure that they are working as intended and their effectiveness must be monitored over time.

Step 4: Verify Controls are Working as Intended

Once complete, workers and supervisors need to be trained on the controls, including how to identify conditions when the control is not working as intended and what to do about it..

[Begin Step 4 \(.pdf\)](#)

Step 5: Conduct Follow-ups

Conduct follow ups to ensure controls are working as intended and there are no unintended consequences, such as "work arounds." Ensure any controls modified or implemented did not add to or create new hazards.

[Continue to Step 6](#)

Step 4-5: Check – Efficacy of Controls

Step 4. Risk Assessment Controls and Verification

Using the controls identified and implemented to address opportunities for improvement identified within the risk assessment (Step 4). Controls should be implemented with input from those performing the work to ensure the controls are acceptable and do not create unexpected outcomes.

- Tool 5: Identifying Potential SIF Hazards
- Tool 6: Learning Teams
- Tool 7: Risk Prioritization Tool
- Tool 8: SIF Hazard Control Matrix

HOME / WORKPLACE SAFETY / SIF PREVENTION MODEL

ACT - Continuous Improvement

PLAN

DO

CHECK

ACT

Drive Continuous Improvement in SIF Prevention Programs and Strategies

The final step in the SIF model is to drive continuous improvement by addressing the SIF-related management system gaps identified in the first step of the model. This document provides a list of suggestions.

[Step 6 - ACT Checklist \(.pdf\)](#)

Congratulations! You Have Completed the SIF Model

However, there is always room for improvement. Consider revisiting the model periodically and improving your controls.

[Return to the Start of the SIF Model >](#)

[Contact Us >](#)

References

- [Serious Injury and Fatality Prevention: Leading Indicators, Cumulative Risk and Safety Networks – Campbell Institute](#)
- [Designing Strategy for Serious Injury and Fatality Prevention – Campbell Institute](#)
- [Serious Injury and Fatality Prevention: Perspectives and Practices – Campbell Institute](#)
- [NSC Networks](#)
- [Severe Injury Reports – OSHA](#)
- [Fatality Inspection Data – OSHA](#)
- [On-site Consultation Program – OSHA](#)
- [EU prevention and control strategies](#)

Next Steps

- Spread the word!
- Use the model and provide feedback to NSC
- NSC Networks will be working to influence government agencies, international standards, professional organizations, ESG reporting, and organizations of all industry and size.
- ASTM Workgroups to develop 3 new standards
 - Severity Based Metrics
 - High Risk Reduction
 - Employee & Leadership Engagement
- NSC will continue to update and refine the model

Questions