Prevention Through Design

Proven Solutions From the Field

By David L. Walline

Causal data from serious and fatal injury events suggest that the decisions arising from the prevention through design (PTD) process play a central role in avoiding such events. Numerous studies and research reveal that 20% to 50% of all mishaps reported a design gap finding. For example, Australian Safety and Compensation Council (2006) explains how the design of machinery and equipment affected the incidence of fatalities and injuries in Australia: "Of the 210 identified workplace fatalities, 77 (37%) definitely or probably had design-related issues involved. Design contributes to at least 30% of work-related serious nonfatal injuries" (p. 6). The author's firsthand experience and study suggests that such events are at the high end of this range.

The central question then becomes what is preventing organizations from addressing design-related events. The author believes a critical organizational and cultural blind spot exists. Benchmarking with other OSH professionals indicates that most injury/illness data management systems do not ask for, capture or call attention to design-related causal factors. This data gap has caused design-related latent conditions to go uncontrolled and undetected by most organizations. As a result, existing and new designs continue to be developed with inherent uncontrolled hazards and risks that have the potential to cause serious mishaps.

To avoid design-related mishaps, OSH professionals can conduct a deep dive into their organizations' injury/loss experience. Such an internal critical examination often produces startling results that can be used to drive a new and necessary focus on PTD. For example, the author's work has led to the development of design safety checklists centered on control measures related to past serious mishap/fatality events (Table 1, p. 45). When stakeholders such as engineers, safety professionals, designers, builders/fabricators and contractors understand how design gaps have led to catastrophic outcomes, the justification for using high-level control becomes evident.

IN BRIEF
- OSH professionals and engineers must know the percentage of incidents in their organizations that are directly linked to design-related causal factors.
- Incorporating data-driven learning from past mishaps and proven (risk mitigation) solutions into new designs or redesigns enables organizations to design out fatalities and prevent serious mishaps.
- The OSH community must dispel and overcome safe design myths within their organizations to propel a prevention through design culture change.

PTD Skill Building

ASSE's (1994) position statement on designing for safety (another term for PTD) states:

> Designing for safety (DFS) is a principle for design planning for new facilities, equipment and operations (public and private) to conserve human and natural resources, and thereby protect people, property and the environment. DFS advocates sys-

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tematic process to ensure that state-of-the-art engineering and management principles are used and incorporated into the design of facilities and overall operations to assure safety and health of workers, as well as protection of the environment and compliance with current codes and standards.

As a starting point to enhance PTD skills, OSH professionals should review ANSI/ASSE Z590.3-2011, Prevention Through Design: Guidelines for Addressing Occupational Hazards and Risks in the Design and Redesign Processes. As stated in Section 1.3, Application, the standard applies to four main stages of occupational risk management as follows:

1) Preoperational stage: Initial planning, design, specification, prototyping and construction processes, where the opportunities are greatest and the costs are lowest for hazard and risk avoidance, elimination, reduction and control.

2) Operational stage: Hazards and risks are identified and evaluated, and mitigation actions are taken through redesign initiatives or changes in the work methods before incidents and exposures occur.

3) Postincident stage: Incidents and exposures are investigated to determine the causal factors that will lead to appropriate interventions and acceptable risk levels.

4) Postoperational stage: Demolition, decommissioning or reusing/rebuilding operations are undertaken.

Based on the author's informal research and discussion with many global OSH professionals over the past 5 years, following are rough estimates of how practitioners spend their time:

- preoperational stage: 10% (avoidance and elimination focus);
- operational stage: 70% (compliance and retrofit focus);
- postincident stage: 20% (claims management, litigation, regulatory issues);
- postoperational stage: less than 1% (decommissioning, demolition).

OSH professionals often spend too much time fighting fires or working in compliance mode based on several false beliefs:

1) Business leaders know what they should be doing next in OSH (such as PTD).

2) Nothing can be done in PTD without a corporate edict or standard.

3) PTD is to be left to engineers and designers.

4) If initial PTD efforts are not perfect, the effort is a failure.

5) It is up to others to engage safety professionals in PTD processes.

To move PTD to the forefront of business decision making, the OSH community must begin to spend more time in the preoperational stage. OSH professionals need to shift away from and perhaps exit out of traditional safety roles and daily focus on compliance program development, training, inspections and claims management, and transition into risk avoidance and risk-mitigation activities related to organizational planning, design, specifications, safety procurement specifications, design safety reviews, proven solution development and risk assessment. This entails changing how professionals do their jobs.

The safety professional's job description of the future must look much different than it does today. Progressive employers will want individuals who possess key core competencies (working in the preoperational risk management stage) in PTD, risk assessment, management of change, fatal and serious injury prevention, operational risk management system, contractor risk management, safety specifications for procurement, and human error and human performance.

ANSI/ASSE, Z10-2012, Occupational Health and Safety Management Systems (another highly recommended document), highlights these core competencies. Additionally, ASSE's Risk Assessment Institute has identified 16 risk assessment core competencies for safety professionals (**www.oshrisk.org/fun-core.php**). In the author's opinion, safety professionals should establish a career target (both time and skill set) of spending 70% of their time working in the preoperational stage of risk management. At this stage, the business community can best see OSH professionals as valued business partners and risk mitigation advisors.

Safe Design Myths & Bad Designs

Over time, the author has identified five common safe design myths that must be dispelled. The following statements illustrate these myths:

1) "This design meets minimum compliance, therefore it is safe."

2) "PTD is cost prohibitive. High-level controls are too costly."

3) "PTD will slow the project. We do not have time for design reviews and risk assessment."

4) "Current/old design is safe enough. We have always done it this way, and our injury experience does not prove otherwise."

5) "Low-level controls greatly reduce severity of harm."

In addition, poor designs can negatively influence an entire organization because they can produce serious mishaps, low employee morale, poor product quality, poor operating efficiency, and equipment and process reliability issues. These negative influences are often readily apparent when organizations have incorporated lean manufacturing principles and processes into their operations. During safety and production kaizen events (iSixSigma.com), business leaders, employees and maintenance teams often state that "we could be world class in productivity or safety if the process had been designed differently." Bad design equals bad performance in many areas of business in the global marketplace.

Proven Solutions: A PTD Culture Revolution

In this context, the term *proven solutions* means designing out causal factors through risk avoidance and hazard elimination. ANSI/ASSE Z590.3 outlines a unique hierarchy of controls (Figure 1, p. 46). It is unique in that the most preferred method for achieving acceptable risk in design is risk avoid-

Table 1

Design Safety Checklist Example

Hazard category pathway to injury	Incident description	Year	Normal or abnormal work condition	Severity potential	Design specification	Level of hazard control (ANSI/ASSE Z590.3-2011)
Elevated work (portable ladder use) Fall to level below	Case no. 12345 1) Maintenance worker fell 12 ft to level below onto concrete surface 2) Using hand tool 3) Multiple fractures, concussion, internal organ damage	2010	Abnormal: Outdoor overhead water pipe valve leaking, valve could not be closed by hand	Life ending	1) Design out portable ladder use 2) Design piping system isolation valves at floor (worker level) 3) Procure isolation valves equipped with easy moving handles for opening and closing to eliminate forceful exertions	1) Avoidance of portable ladder use 2) Elimination of elevated work task 3) Substitution of isolation valve—nonsticking 4) Elimination of hand tool use
Powered machinery and equipment (thermal roll machine) In-running nip point Caught in/between	Case no. 678910 1) Employee's hand became caught between high temperature power rolls (180 °F) and fixed guide 2) Three fingers amputated, second-degree burns to right hand	2012	Abnormal: Facing sheet was not adhering to product	Life altering	1) Design machine with guides to keep product in line with rolls to avoid employee interface with material 2) Install fixed guarding to prevent worker access to machine hazard zone with equipment powered up.	1) Avoidance of abnormal condition 2) Engineering controls
Walking/working surface (elevated fixed work platforms) Fall to level below	Case no. 121212 1) Employee fell 14 ft to next work level when steel grating section shifted and gave way under employee's weight and walking motion 2) Severe trauma to multiple body parts	2011	Abnormal: Metal deck plates not secured to support beams at time of installation by contractor (Note: perimeter safety railing in place at time of incident)	Life ending	1) Platform design specification requires metal deck plates to be secured by clamping and welded into place to prevent movement per ANSI/NAAMM Standard MBG 531-09	1) Avoidance of abnormal condition 2) Engineering controls with deck safety clips and weldments with required overlap on support beams 3) Inspection for safety clips and weldments part of installation (administrative)

ance. Avoidance means preventing, by design, hazards from entering the workplace. Avoidance has the greatest net positive impact on safety because no hazards exist to be eliminated or controlled. A good risk avoidance statement begins with a "no" statement (e.g., "No elevated work"). Borne out of each such statement comes a proven solution.

Consider an example of proven solutions in practice. On a large capital project in China (multimillion dollar manufacturing facility), the author worked (2009-11) with the design/build firm to incorporate proven solutions into the plant design by placing each performance objective (what one wants to see at the ribbon cutting) into a no statement. For example:

1) No portable ladders.
2) No powered forklift trucks used in the manufacturing space.
3) No elevated work.
4) No energized electrical work.
5) No manual handling/lifting of manufactured product (45 lb) by production employees.
6) No elevated or remote energy isolation points used for lockout/tagout/try tasks.
7) No open chemical processing and mixing systems.
8) No unsecured trailers while being loaded.
9) No open electrical panels to perform diagnostics or thermography.
10) No fall hazards during construction.
11) No congested or restricted workspace (people, equipment, maintenance, emergencies).
12) No direct interface between employees and powered machinery and equipment (both during normal and abnormal conditions).

Based on these performance objectives, sustainable proven solutions were used. For example:

1) Typical portable ladder tasks were designed out by a) relocating work to ground level; b) making work accessible by fixed stairways/platforms; and c) establishing proper accessway for work lifts.
2) An automated guided vehicle system was implemented to eliminate forklift operations.
3) Electrical energy isolation, arc preventive switch gear/motor control centers and diagnostic ports were used.
4) Piping system isolation valves, gages and filters were located ground level.
5) Trailer restraint system and dock door barrier guards were used.
6) Automated product conveyance and lifting systems were installed.
7) Fully enclosed chemical process and mixing systems were employed.
8) 100% fall prevention was used during construction (e.g., perimeter guarding, skylight guarding, aerial lifts).
9) Employees wore less PPE, not more.
10) Devices were under exclusive control of maintenance worker for approved troubleshooting tasks.
11) All hazardous energy isolation points were located at floor level within ≈10 ft of need.
12) Employees were removed from directly interfacing with powered machinery and equipment through barrier guarding and automated jam clearing systems.

When stakeholders such as engineers, safety professionals, designers, builders/fabricators and contractors understand how design gaps have led to catastrophic outcomes, the justification for using high-level control becomes evident.

Improving Human Performance

ANSI B11.0-2011, Safety of Machinery: General Requirements and Risk Assessment, contains a hazard control hierarchy that clearly outlines the influence that each control level has on the severity and likelihood of risk factors (Figure 2, p. 46).

It indicates that the greatest influence occurs at the elimination or substitution level. Despite this, many perceive that low-level controls have a great impact on severity when they do not. Guarding and engineering controls are excellent risk control measures, but their primary purpose is to reduce likelihood not severity. That is why control effectiveness and control maintainability is vital for sustainable protection.

Figure 1

Hierarchy of Controls

Most preferred	Risk avoidance: Prevent entry of hazards into a workplace by selecting and incorporating appropriate technology and work methods criteria during the design processes.
	Eliminate: Eliminate workplace and work methods risks that have been discovered.
	Substitution: Reduce risks by substituting less hazardous methods or materials.
	Engineering controls: Incorporate engineering controls/safety devices.
	Warning: Provide warning systems.
	Administrative controls: Apply administrative controls (the organization of work, training, scheduling, supervision, etc.)
Least preferred	Personal protective equipment: Provide PPE.

Note. *Adapted from ANSI/ASSE Z590.3-2011.*

Applying proven solutions can enhance human performance by addressing human error influencers such as:

- high ambient noise and/or temperatures;
- poor job lighting;
- poor ergonomics (e.g., layout, job set up, work space);
- PPE loading and barrier to job completion;
- responding to routine process upsets, jam-ups, abnormal conditions;
- performing complex work;
- performing physically demanding work that induces fatigue;
- use of hand tools that draw a worker close to the hazard;
- uncontrolled hazard/energy sources;
- distractions (e.g., multitasking, alarms, weather conditions).

When looking at causal factors related to design gaps, one or more of the human error influencers can be present at the same time. Proven solutions also support the safe behaviors that eliminate common human error factors.

The sea change that is created by PTD is reflected when managers, business leaders and others make these types of statements:

- "Design the work so it is easy to do it safely and difficult to do it wrong."
- "Severe work injuries will have more impact on the organization than stopping production to make it safe."
- "Never underestimate having a bad outcome from a person who wants to do well."
- "Administrative and PPE controls will never replace the appropriate safe guards."

Figure 2

Hazard Control Hierarchy

Most preferred	Protective measures	Examples	Influence on risk factors	Classification
	Elimination or substitution	•Eliminate pinch points (increase clearance) •Intrinsically safe (energy containment) •Automated material handling (robots, conveyors, etc.) •Redesign the process to eliminate or reduce human interaction •Reduced energy •Substitute less hazardous chemicals	•Impact on overall risk (elimination) by affecting severity and probability of harm •May affect severity of harm, frequency of exposure to the hazard under consideration, and/or the possibility of avoiding or limiting harm depending on which method of substitution is applied.	Design out
	Guards and safeguarding devices	•Barriers •Interlocks •Presence sensing devices (light curtains, safety mats, area scanners, etc.) •Two hand control and two hand trip devices	•Greatest impact on the probability of harm (occurrence of hazardous events under certain circumstances) •Minimal if any impact on severity of harm	Engineering controls
	Awareness devices	•Lights, beacons and strobes •Computer warnings •Signs and labels •Beepers, horns and sirens	•Potential impact on the probability of harm (avoidance) •No impact on severity of harm	Administrative controls
	Training and procedures	•Safe work procedures •Safety equipment inspections •Training •Lockout/tagout/tryout	•Potential impact on the probability of harm (avoidance and/or exposure) •No impact on severity of harm	
Least preferred	PPE	•Safety glasses and face shields •Ear plugs •Gloves •Protective footwear •Respirators	•Potential impact on the probability of harm (avoidance) •No impact on severity of harm	

Note. *Adapted from ANSI B11.0-2011.*

Reducing Overall Burden Costs

Any capital project carries two monetary expenditures: 1) pay now, which is the cost of the new design, and 2) pay later, which is the long-term burden costs. Burden costs commonly linked to a facility's life expectancy include injury claim costs, compliance maintenance costs, retrofit costs, business interruption, operating inefficiencies, resource management and manpower costs. Firsthand experience shows that long-term burden costs often far exceed those of the original design solution that would have eliminated the entire hazard category.

Table 2

Typical Burden Costs: Compliance-Related Program

People	Equipment	Methods
Training	Purchase	Scheduling/planning
Buddy systems	Rental	Written program
PPE	Repair/maintain	Safe work procedures
Supervision	Clean	Audits/inspections
Injuries	Retrofit	Permits
Claims	Storage	Observations
Citations/penalties	Transport device	Investigations

Burden costs commonly linked to a facility's life expectancy include injury claim costs, compliance maintenance costs, retrofit costs, business interruption, operating inefficiencies, resource management and manpower costs.

Thus, a key PTD selling point is the long-term burden costs that an organization will incur when hazards are not avoided or eliminated in the design or redesign phase. Communicating the burden costs incurred when low-level controls are selected over one-time, high-level controls designed to avoid or eliminate hazards and risks represents an opportunity for OSH professionals.

It is also important to educate decision makers that burden costs must be maintained throughout the facility's life expectancy, and these costs can be extreme. Table 2 shows the typical long-term burden costs associated with compliance-related programs such as ladder safety, forklifts, confined space entry and respiratory protection.

Now, consider an example involving portable ladder use in a typical manufacturing setting. Falls from ladders are often life altering or fatal, and portable ladders are a leading cause of OSHA violations. For one project, the author determined that burden costs of portable ladder use in a 500,000-sq.-ft. facility with a planned 50-year life span could be as much as $9.3 million (Table 3, p. 48).

Using proven solutions to design out (risk avoidance) the 17 defined routine ladder tasks (175 ladder users) in the concept stage would require a one-time capital investment of $500,000. This is a noteworthy net positive gain, as is never having a portable-ladder-related mishap (fatality or life-altering injury) at the facility. It is important to remember that the ladder and its user are both lower-level controls. A safe ladder and safe user do not achieve low risk. Therefore, the focus must shift from ladder compliance programs to ladder avoidance through design.

Impact on Risk Level

On another project, the author uncovered a significant risk factor when performing an in-depth review of bad design causal factors that were not previously seen. The key risk factor discovered was the impact of a congested or restricted access or workspace on worker safety. One common way to control project costs is to reduce floor space or

Burden costs often far exceed the original design solution cost that would have eliminated the entire hazard category. For example, building HVAC can be installed at ground level to ensure safe access.

the facility's footprint. The result is less workspace and/or restricted access to equipment for maintenance tasks.

In some cases, this forces operations management to purchase portable ladders because the design provides no workspace or access for alternative safer designs such as stairways, personal lifts and hoisting equipment. Table 4 (p. 48) illustrates how restricted access/workspace affects risk, design and long-term burden costs. It indicates that placing piping system isolation valves at ground level would achieve a negligible risk level rating and avoid long-term burden costs. This single example highlights the positive impact PTD can have on reducing long-term burden costs and mishaps.

Risk Assessment Incorporated Into PTD

The author's in-depth, nonscientific study reveals these trends:

1) Task-based risk assessment is often a critical missing component in the PTD process.

2) Design safety reviews often do not have a special focus on abnormal conditions and/or infrequently performed tasks.

3) Heavy reliance on low-level controls (i.e., warning systems, administrative controls, tools, PPE) does not provide appropriate protection to workers at the time of a mishap. In most cases, controls do not match risk levels.

This presents an opportunity to incorporate risk assessment, design specifications and proven solutions into a unified PTD process. A task-based risk assessment (On Safe Lines) worksheet (Table 5, p. 49) helps identify design specifications and proven solutions that can be incorporated into the new design to achieve a project design performance ob-

A parapet wall on a hotel roof provides passive fall protection to protect workers servicing HVAC equipment.

jective (e.g., no portable ladders) and a design residual risk target (e.g., prevent elevated falls).

Business Value & Benefits Gained From PTD

The benefits derived with safe project delivery are another key PTD selling point. Recall the new plant built in China. The proven solutions incorporated into that facility's design helped produce these additional benefits:

•Project came in significantly under budget.

•Lower energy was consumed throughout the project.

•Zero waste was taken to a landfill, meaning an overall net positive impact on the environment.

•Plant sold out its product line and achieved full production capacity ahead of schedule.

•Worker morale was high.

•Operating efficiency targets were achieved ahead of schedule.

•Plant design and all job tasks achieved acceptable risk rating.

•At time of this writing, no serious mishaps or near-hit events have been reported since plant start-up in 2011.

•The design team and project champion were recognized by the CEO and company leadership.

It is important to educate decision makers that burden costs must be maintained throughout the facility's life expectancy, and these costs can be extreme.

Table 3

Example Project Risk Profile & Burden Cost Output From Design Safety Reviews

Design category	Risk level	Burden costs
Roof	Moderate	$25k/year
Electrical	Moderate	$50k/year
Piping systems	Low	$5k/year
Product movement	Negligible	None
Product handling	Negligible	None

Table 4

PTD's Impact on Risk Level

Design	Bad	Marginal	Better	Best
Access: Work space	None	Access by man-lift	Access for fixed work platform and stairs	Relocate isolation valves to ground level
Work elevation	Portable ladder	Man-lift	Fixed work platform with stairs	Work at ground level
Risk level	High	Moderate	Low	Negligible

Successes such as these make clear that proven solutions that avoid risk and eliminate hazards in design must be the OSH profession's legacy rather than programs and firefighting. Knowing that the 350 employees of this world-class facility can return home injury- and illness-free each day is the true reward of these efforts. OSH professionals can elevate their value to their organizations by showcasing how they can help design for acceptable risk through sustainable, high-level controls.

PTD Action Steps for OSH Professionals

OSH professionals can create and maintain a library of risk-based proven solutions that will expedite future design safety reviews that may encompass similar exposures and risks. This will help eliminate the PTD myth that "we don't have time for design reviews and risk assessment."

Several resources are available to help OSH professionals develop a proven solution library. For example, ASSE has several:

•Risk Assessment Institute (**www.oshrisk.org**);

•Body of Knowledge (**www.safetybok.org**);

•PTD initiative (**www.asse.org/professionalaffairs/ptd**);

•Risk Assessment Certificate program (**www.asse.org/education/cert-prog**);

•virtual PTD symposium (**http://eo2.commpartners.com/users/asse/session.php?id=10516**).

Other resources include:

•NIOSH's national PTD plan (**www.cdc.gov/niosh/programs/PtDesign**);

•OSHA Alliance Design of Construction Safety initiative (**www.designforconstructionsafety.org**);

•Construction Industry Institute (**www.construction-institute.org**).

OSH professionals can also incorporate lessons learned from completed design projects, benchmark, and seek input from engineers, designers, vendors, suppliers and hourly workers.

In addition, OSH professionals are encouraged to take the following actions to start a culture revolution around PTD. The rewards and benefits will be many, the most noteworthy being the prevention of life-ending and life-altering mishaps.

1) Create a design safety checklist from organizational incident data that relate to design gaps.

2) Know and communicate the percentage of organizational incidents caused by design gaps.

3) Establish a personal goal to spend more time working in

Table 5

Task-Based Risk Assessment Example: Ladder Tasks

No.	Ladder task (exposure) operator, maintenance, contractor	Hazard elevated work (magnitude)	Severity (internal/ external data)	Probability (internal/ external data/level of control)	Task risk level (initial) with ladder use	Design specification (to avoid, eliminate portable ladder use)	Proven solutions (avoid, eliminate, substitute or engineering control) to achieve residual risk target	Residual risk (design target achieved?) (Y/N)
1	Overhead light fixture install or service	Fall to level below (15 ft) (concrete surface)	Cat. (5)	Occasional (OSHA/BLS data, low level of control) (3)	Very high (15)	Provide unobstructed minimum 10-ft wide floor access to and 100 sq.ft (10 x 10 ft) around light fixture for access by man-lift	Individual man-lift with protective railings and personal restraint	Cat. (5) Unlikely (1.5) Residual risk (7.5) Moderate (50% risk reduction) Yes
2	Piping systems isolation valve install or service	Fall to level below (15 ft) (concrete surface)	Cat. (5)	Occasional (OSHA/BLS data, low level of control) (3)	Very high (15)	Design piping system for operation of isolation values at ground level	Isolation horizontal valves placed at floor level (4 ft)	Cat. (1) Unlikely (1) Residual risk (1) Low (95% risk reduction) Yes
3	Access to top of chemical storage tank for inspection and service	Fall to level below (20 ft) (concrete surface)	Cat. (5)	Occasional (OSHA/BLS data, low level of control) (3)	Very high (15)	Provide unobstructed space for tank access to install fixed stairway, work platform with protective railings	Individual man-lift or horizontal lifeline for installation, provide fixed metal stairway and work platform with protective railings for users	Cat. (5) Unlikely (1.5) Residual risk (7.5) Moderate (50% risk reduction) Yes

Severity	Probability	Risk level
Catastrophic (5)	Frequent (5)	Very high (15+)
Critical (4)	Likely (4)	High (10-14)
Marginal (3)	Occasional (3)	Moderate (6-9)
Negligible (2)	Seldom (2)	Low (1-5)
Insignificant (1)	Unlikely (1)	

The design performance objective in this example was "No portable ladders" (risk avoidance). To make the business case, personnel noted that falls from portable ladders often cause life-altering or fatal injuries. The design target (residual risk) was to prevent elevated falls.

Note. *Matrix adapted from ANSI/ASSE Z590.3-2011.*

the preoperational stage of occupational risk management.

4) Develop a critical skill set around PTD and risk assessment.

5) Apply a high level of control decision making in the design process with special focus on severity reduction.

6) Identify and share with leaders and design teams the long-term burden costs related to poor design decision making.

7) Work to dispel common safe design myths.

8) Eliminate barriers to safe work through design.

9) Capture and communicate the many benefits from safe design.

10) Incorporate task-based risk assessment and safe design specifications into the PTD process.

Conclusion

Field experience has shown that incorporating proven solutions into design is critical to the prevention of life-altering and fatal mishaps. These solutions have global application and can bring demonstrated value to any organization. As with all approaches to risk mitigation, OSH professionals must consider all forms of mitigation, and be creative and fiscally responsible. It is also important to consider human factors, the unpredictability of human-machine interactions and human decision making. The pace of injury/illness prevention improvement is directly linked to the speed of change led by OSH professionals. Risk assessment and PTD must be at the forefront of the profession's efforts. The community has the responsibility, creativity and power to ensure injury-free lives around the world. This must be its legacy. **PS**

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