# Fatality Prevention

## Findings From the 2012 Forum

By Jan K. Wachter and Lon H. Ferguson

A 2-day fatality prevention forum was held in late October 2012 to examine the nature and cause of fatalities in the workplace and recommended prevention strategies. It was a natural extension of the 2007 Fatality Prevention Forum (Cekada, Janicak & Ferguson, 2009). The 2012 forum had these objectives:

1) Identify practical approaches a facility can use to develop a risk profile.

2) Recognize the most effective leadership styles and organizational attributes necessary for a fatality prevention effort, including (but not limited to) training, root-cause analysis and employee engagement.

3) Determine the role of human performance concepts in preventing fatalities, especially as it relates to human-systems integration and the recognition/elimination of error precursors.

4) Evaluate the influence of a person's perception of risk, the required mental and physical aspects of the task, latent conditions and performance modes as they relate to fatality prevention.

5) Discover best practices, innovative technological concepts and tools that have the potential to transform the ability to identify, assess, mitigate or eliminate the risk of fatal and life-altering injuries.

6) Identify areas of future safety research and public policy that could drive significant improvement in the ability to predict and prevent fatalities.

These objectives were met through a series of presentations, best practices showcases and breakout sessions. The breakout sessions served to document actual best practices used to prevent fatalities and serious injuries (FSIs) as they relate to one of these areas:

- leadership and organizational attributes;
- developing a risk profile;
- effective risk assessment methodologies;
- managing the contractor/contracted services risk;
- effective control for high-risk tasks.

### Presentation Highlights

Several key themes emerged, as reflected in the findings presented in select presentations (Fisher, 2012; Krause, 2012; Newell, Comingore, Murray, et al., 2012).

**IN BRIEF**

- **Indiana University of Pennsylvania, in cooperation with Alcoa Foundation, DuPont Sustainable Solutions, Edison Mission Group and U.S. Steel, hosted an international 2-day forum to study the nature and cause of workplace fatalities, as well as to recommend prevention strategies.**
- **Three key findings emerged:**

**1) A new measure, the fatalities and serious injuries (FSI) potential rate, is being advocated for use in measuring an organization's risk for having FSIs.**

**2) To reduce FSIs, organizations need to identify, understand and control the precursors of all incidents that have the potential to cause FSIs.**

**3) Management of risk associated with FSI precursors must occur at the task level—individual tasks must be analyzed and controlled for their FSI potential.**

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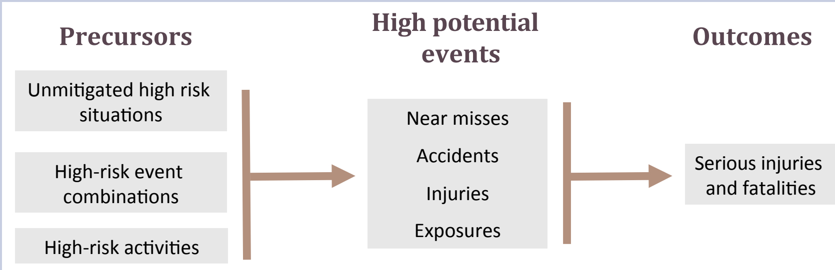
Figure 1

## The New Paradigm




***Note.** Adapted from "New Perspectives in Fatality and Serious Injury Prevention," by T. Krause, 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA.*

**In the new paradigm, all minor injuries are not the same. Injuries of differing severity have differing underlying causes, and reducing serious injuries requires a different strategy than reducing minor injuries.**

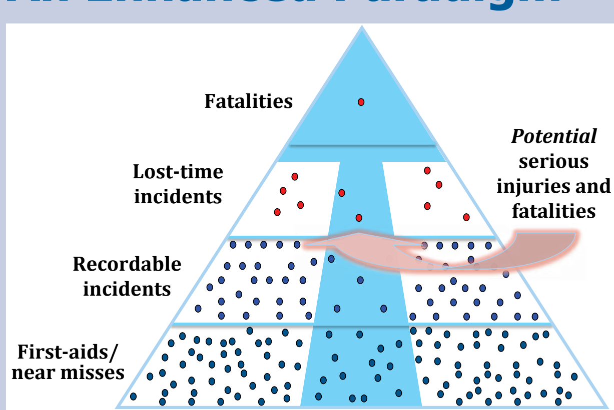
### *Theme 1: New Paradigms, Models, Frameworks & Tools for FSI Prevention*

A new framework for FSI prevention is being advocated to resolve a common issue for leading companies in the area of safety performance: Recordable and lost-time injury rates are declining steadily, but fatality rates are level or increasing (Krause, 2012). This is contrary to what has long been presented in the safety triangle—that minor injuries predict serious injuries and that by controlling the causes behind minor injuries, serious injuries will also be controlled. According to Krause, an FSI prevention study involving several organizations was conducted to develop a model to understand and prevent FSIs. Using data from participating companies, these questions were studied: Is the traditional safety triangle accurate descriptively? Is it predictive? Is it possible to develop intervention principles, criteria and methods to address FSI events?

The study found that the triangle is accurate descriptively (e.g., one fatal incident occurs every *x* times when a serious incident occurs) (Krause, 2012). Implications of the triangle's descriptive validity are that it provides an accurate description of the quantitative nature of incidents and provides insight that informs prevention strategies. It means that a single incident has significance (i.e., single incidents inform people about the system).

Figure 2

## An Enhanced Paradigm




***Note.** Adapted from "Best Practices Showcase: Exxon Mobil Corp.," by G. Murray, 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA.*

However, the study also showed that the traditional triangle is not accurately predictive (Krause, 2012). In other words, not all injuries have FSI potential (or the same FSI potential). A reduction of injuries at the bottom of the triangle does not necessarily correspond to an equivalent reduction of FSIs. Of the 300 sampled injuries, 64 had the potential to be FSIs.

According to Krause (2012), FSIs are disproportionately related to certain types of activities and to certain types of safety controls. For example, most incidents associated with operation of mobile equipment or watercraft, or working under suspended loads are considered to be FSI type activities. Based on such analyses, FSI precursors (i.e., unmitigated high-risk situations that will result in a serious or fatal injury if allowed to continue) can be identified that will inform intervention strategies.

An example of a precursor is an employee working on the bottom of an elevated vessel with no approved place to secure a lanyard. Other examples of activities that may have high proportions of precursor events are mobile equipment (operation and interaction with pedestrians), confined space entry, jobs that require lockout/tagout, lifting operations, working at height, caustic liquor handling and manual handling. Situations that may have high proportions of precursor events include process instability, significant process upsets, unexpected maintenance, unexpected changes, high-energy-potential jobs and emergency shutdown procedures.

Based on these findings, Krause (2012) argues for a new paradigm (Figures 1 and 2). The old paradigm holds that 1) all low-severity injuries have the same potential for serious injury; 2) injuries of differing severity have the same underlying causes; and 3) one injury reduction strategy will reach all kinds of injuries equally (e.g., reducing minor injuries by 20% will also reduce major injuries by 20%).

In the new paradigm, all minor injuries are not the same (Krause, 2012). However, specific subsets of low-severity injuries are associated with FSI precursors. Also, injuries of differing severity have differing underlying causes, and reducing serious injuries requires a different strategy than reducing minor injuries. To reduce serious injuries, one should use precursor event data drawn from sources such as incidents, injuries, near-misses and exposures. The old paradigm could be shifted by focusing on managing and classifying events according to their potential for serious injuries based on precursor events indicating unmitigated high-risk situations. This shift is predicted to lead to greater focus on preventing serious injuries, ultimately resulting in lower rates of such injuries.

Krause (2012) proposes a five-step plan to prevent FSIs:

•**Step 1:** Educate the organization on the new paradigm for FSIs.

•**Step 2:** Institutionalize the use of an FSI rate (also known as the FSI potential rate). This rate is the number of fatal injuries, serious injuries and recordable injuries with high potential (for FSIs) divided by hours worked. Data on the rate should be gathered for the previous 2 to 3 years, then monthly into the future. It should be given high visibility throughout the organization. The critical importance of the FSI potential rate is that it gives visibility to FSI performance as a leading and lagging indicator; it enables new research needed to develop intervention strategies; it enables root-cause analysis of large numbers of potential FSI events; and it sets the stage for predictive analytics.

•**Step 3:** Integrate findings from the FSI study with existing safety systems. Some examples include incident investigation, observation and feedback, pretask risk assessment and data analysis systems.

•**Step 4:** Develop mechanisms for the ongoing identification and remediation of FSI precursors. These include longitudinal analysis, predictive analytics and discovery conversations. For example, 87% of FSI cases studied had underlying precursors/preconditions/root causes that were discoverable from interview-based observations.

•**Step 5:** Develop and validate an intervention strategy. This can be accomplished by identifying the intervention group, gathering baseline FSI rate data, designing and implementing an intervention plan, and tracking FSI rate data to measure effectiveness (Krause, 2012).

The Mercer ORC Fatality and Serious Injury Prevention Task Force (Newell, et al., 2012) also studies evolving concepts in FSI prevention and has proposed a new model that creates a dual track for addressing risk (Figure 3, p. 44): one track for less serious personal safety hazards and another track for hazards with FSI potential.

The new model emphasizes the need for a heightened sense of awareness and vulnerability in precursor situations. The approach is also task-based. Multiple hazards are evaluated for each task with points being assigned for each hazard. Hazard severity rating combines different hazards with related human factors and organizational deficiencies to develop a full understanding of the risk. Although combined for risk assessment, the different hazards and underlying factors are disaggregated to implement and track corrective actions.

A framework and tools for implementing this model are available. An integrated workbook approach to FSI prevention is being advocated. This includes a new model for identifying precursors to FSIs. Precursor data may vary by industry, employer, business unit and even site. Therefore, companies should begin looking for FSI precursors by examining their own data and creating an inventory of their own serious hazards. Underlying conditions that could activate or intensify the hazard should also be factored into the hazard inventory.

The integrated workbook approach also includes a new risk assessment model that determines likelihood by degree of control, not by estimates based on past experience. Precursor hazards are evaluated based on the hazard's potential severity, the degree of current control and the number of workers exposed. Related human factors and organizational deficiencies are also evaluated and integrated into the risk assessment. The result is a final risk score that can be used to set priorities for FSI intervention.

This approach also drives continuous improvement around hazard mitigation and helps management address key underlying factors that could create problems. A new safety cultural assessment tool is also being advocated; it examines organizational characteristics that may contribute to the likelihood of an FSI.

This integrated approach also includes new approaches to risk mitigation that provide a framework for determining appropriate layers of protection (LOP) (Figure 4, p. 45). Occupational FSIs may continue to occur because decision makers incorrectly apply the hierarchy of controls to corrective actions, often relying on lower-order controls. During incident investigations, causality may have focused on personal safety accountability and decision making; this can result in overapplication of administrative controls (e.g., updated procedures, retraining) instead of higher-order controls such as elimination, substitution and engineering design/redesign. Also, a focus on mitigating the exposure should be embraced in the overall strategy for preventing FSIs.

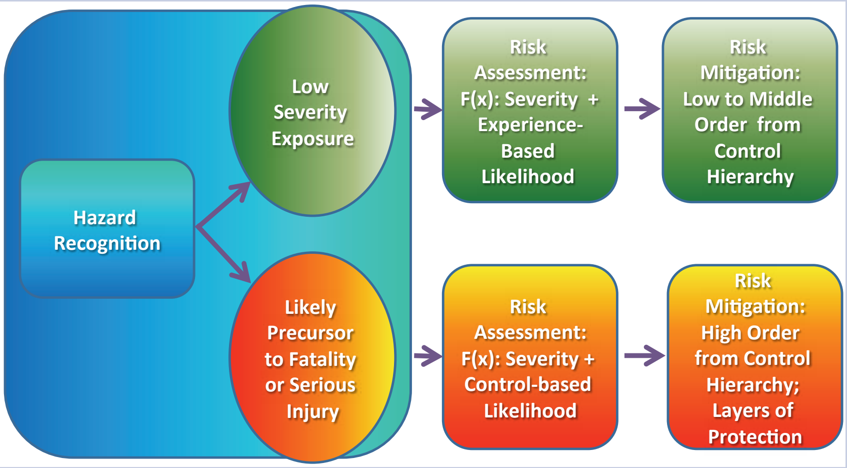
The framework supports developing a compendium of control options for FSI prevention. These control options include management of change guidance, prevention through design options, engineering (postinstallation or design) controls, administrative/procedural controls and administrative/task-based controls.

Aspects of error are incorporated into this framework. However, the model creators believe there is a basic misunderstanding of human error, fueled by flawed incident investigations that frequently focus on affixing blame and concentrate on the last factor in a chain of events leading up to the incident. Consequently, organizational factors that contribute to serious incidents are frequently overlooked or misunderstood. Greater focus must be placed on different aspects of error, including organizational factors that lead to intentional and unintentional behaviors that contribute to FSIs. Empirically speaking, effective techniques for minimizing error must be identified and tested, and an incident investigation tool that incorporates performance modes (Wachter & Yorio, 2013) and key underlying factors is being developed.

New checklist tools for conducting more informed incident investigations are available as well. A checklist approach ensures operational consistency in key steps in the process, particularly since memory and judgment are unreliable. Checklists remind people about the necessary, most important and critical steps. If used correctly, checklists are precise, efficient, focused and easy to use, even in the most difficult situations (Newell, et al., 2012).

**Greater focus must be placed on different aspects of error, including organizational factors that lead to intentional and unintentional behaviors that contribute to FSIs.**

## Figure 3
# Dual-Path Strategy for Prevention




***Note.*** *Adapted from "Best Practices Showcase: Introducing a Global Fatality Prevention Strategy—Progress to Date, Kimberly-Clark," by D. Jacobi, 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA; and "A Model for Fatality and Serious Injury Prevention," by S. Newell, R. Comingore, G. Murray, et al., 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA.*

**The traditional Heinrich model and supporting principles have been determined to be descriptive, but not predictive, in nature.**

### *Theme 2: Managing Error Traps in Procedures & Processes*

Fisher (2012) offers keys to improving work methods and instructions using a human perspective improvement approach to managing the causation of injuries. This approach includes understanding the major error traps in procedures and processes. Fisher explains that the fit, form and content of instructions have a marked effect on fatality prevention.

He points to five major error/procedure traps. The first trap relates to making field decisions when a procedure user must make a decision with little or no guidance for doing so (e.g., if a user needs to decide what to do out of multiple options without guidance, has to determine whether certain conditions exist or whether certain sections of a procedure are applicable). Decisions made in error-prone situations have a field error rate 11 times higher than that of a well-written step.

The second trap is physical or mental difficulty. For example, an employee is told once how to do something (e.g., in training, via memo), and now the individual must remember to use it and how to do so correctly. Or, perhaps the employee has been told earlier (in precautions, limitations or procedure steps) and now must determine when to apply it. Physical difficulty includes difficult tasks, unnecessary or unreasonable tasks, or tasks easy to shortcut.

The third trap is multiple actions (including embedded actions) in procedures, such as three or more actions in the same step, actions in a note, caution or warning statement (real or embedded), or actions in the precautions, limitations and prerequisites section.

The fourth trap is using vague terms and misleading information. Vague terms include verbs such as "determine" and "review," adjectives such as "sufficient" and "periodically" and phrases such as "when directed." Use of double-negative statements in procedure steps greatly increases the error rate of the step (Fisher, 2012). Misleading information is incorrect information, but it is not easy to detect and to avoid the error traps it creates. It may involve missing critical steps to execute a task or missing critical references. The most effective ways to discover misleading information are walk-throughs of procedures and full scope verification of procedures.

The fifth trap involves conflicting instructions—actions required by procedural steps that are contrary to the normal actions a worker expects or formats that seem to be different to the user. Fisher (2012) notes that procedures can be a solid offensive weapon for reducing error if procedure writers are taught to avoid these traps and users are taught how to deal with them before they produce an error.

## Best Practices Showcases

Several organizations also shared insights related to their best practices.

### *Fatality Prevention: Barriers to, Enablers of & Lessons Learned*

Shockey (2012) shared Alcoa Inc.'s historical challenges in its fatality prevention journey. He recommends that companies focus on several factors:

1) supervision with a widening span of control;

2) tendency to view people as a constant rather than as the biggest variable in the equation;

3) reliance on single LOP where the risk is high, deviation potential is high and the ability to observe is low;

4) failure to recognize that fatality exposures exist at the task level;

5) risk perspective being biased and limited by personal experiences or a narrow band of the other's experiences;

6) ability and capacity to manage and keep up with the rate of change at all levels;

7) rapid loss of institutional knowledge about historical fatalities and risks.

According to Shockey (2012), specific enablers have made a difference in Alcoa's fatality prevention journey. He notes that it begins with leaders who are emotionally committed and are made acutely aware of fatality potentials within their sphere of influence. Alcoa management challenges paradigms and expectations of what is an acceptable risk, then develops tools to identify and recognize catastrophic potentials. These potentials include patterns of latent conditions and at-risk actions, exposures associated with specific time frames, exposures associated with sources of energy and exposures where people are likely to be present.

Alcoa's strategy is to test, reinforce and manage high-risk exposures daily. The company has developed a specific plan focused on fatality prevention in which its fatality prevention standard ("We value human life above all else and will manage risks accordingly") sets the expectation.

Figure 4

## Layers of Protection Guidelines

| Uncontrolled | Marginal | Controlled |
|---|---|---|
| 0-1 Administrative LOP and no other LOP | 1 Admin LOP + 1 Warning Device LOP | Marginal Risk + 1 Additional LOP + Routine Compliance Auditing |
| | or | or |
| | 1 Admin LOP + 1 Safety Device LOP | 5 Admin LOPs that involve "another set of eyes": a + b + c + d + f, or g + Routine Compliance Auditing |
| | or | |
| | 1 Admin LOP + 1 Additional Admin LOP that involves "another set of eyes": b, or f, or g | **All controlled (acceptable) LOPs must be verified** |

**Administrative LOPs:**
a) Written procedures,
b) Pre-job Assessment involving multiple people,
c) Training,
d) Task Specific Personal Protective Equipment,
e) Isolation/Distance - limit time of exposure or increase distance,
f) Inspection process/Observation/Auditing at time of task,
g) Dedicated Spotter for task: example Confined Space Observer (Observer for duration of job),
h) Emergency response equipment - showers/eyewash/DAP

**Warning Devices LOPs:**
Alarms,
Sensing devices,
Signs,
Barricade Tape,
Backup Camera

**Safety Devices LOPs:**
Physical barriers,
Machine guards,
Relief valves,
Interlocks,
Check valves

**Design LOPs:**
Engineering Solutions

***Note.*** *Adapted from "Best Practices Showcase: Alcoa Inc.," by J. Shockey, 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA.*

**The integrated approach also includes new approaches to risk mitigation that provide a framework for determining appropriate layers of protection.**

The firm systemically identifies risks by reporting, reviewing and analyzing past major incidents, including those without injury, using a risk assessment tool to develop a fatality risk profile, and recording identified risks in a database. Workers (and contractors) are empowered to stop work if an unacceptable risk cannot be effectively reduced or controlled. In addition, the company implements concepts such as LOP, improved causal factors analysis and a focus on the high-risk tasks of the day. The company also acknowledges the presence of human performance triggers and traps ("To err is human: look for it, plan for it, defend against it") and uses human performance tools in particular to defend against human error (Wachter & Yorio, 2013).

The company also has institutionalized a lessons learned program. Shockey (2012) shares these top 10 lessons from Alcoa's fatality prevention journey:

1) Have a plan (roadmap). Knowing a company's risk profile provides focus and direction to the plan.

2) Manage the exposures (predictive), not the outcomes.

3) Senior leadership sets the tone.

4) Organizations cannot prevent fatalities without engaging those who perform the work.

5) Developing workers' hazard recognition and risk assessment skills is essential. Actively looking for hidden potentials must be a daily, sustained focus.

6) Fatalities occur at the task level and are influenced by multiple causal factors.

7) Relying on a single LOP for high-risk tasks makes an organization vulnerable.

8) Individual perception of risk is often biased and limited by personal experiences.

9) Change management matters at all levels of the organization.

10) Organizations must capture institutional knowledge about hazards and risks to advance the next generation's chance for success.

### *Life-Changing Injury & Fatality Elimination*

According to Williams (2012), over a 10-year period, International Paper has experienced a significant decrease in total injuries (56%), yet serious injuries have not declined proportionately (33%). To address this issue, in 2010, the company launched LIFE, a multiyear effort to identify and mitigate the potential hazards and risks that lead to FSIs. LIFE stands for life-changing injury and fatality elimination, and the organization has set a LIFE goal of zero.

A LIFE incident is defined as a fatality, amputation or an injury that results in 14 or more calendar days away from work and involves organ damage, concussion or other brain trauma, bone fracture, crushing injury, degloving, and/or serious second- or third-degree burns.

The strategy has nine components:

1) Communicate effectively.

2) Engage stakeholders.

3) Make safety a core value.

4) Learn from past mistakes (called LIFE lessons).

5) Benchmark best practices.

6) Use manufacturing excellence tools, project teams and be data driven.

7) Train and educate on LIFE (e.g., LIFE leader guide, LIFE newsletter).

8) Change the way that safety performance is measured (use leading indicators).

9) Be global (in terms of engagement).

To learn from past mistakes, LIFE lessons (a one-page summary of incident investigation findings and corrective actions) are distributed throughout the company.

According to Williams (2012), incident analysis under this program has led to the creation of focus areas based on their contribution percentage to LIFE events: machine guarding, 30%; falls, 27%; other (e.g., primarily acute trauma due to material handling), 18%; motorized equipment, 17%; harmful substances or environments, 6%; and driver safety, 2%. Project teams were formed to focus on these five focus areas. For example, in the motorized equipment focus area, several initiatives were conducted or implemented in 2011: pedestrian safety training, traffic flow risk assessments, motorized equipment operator training and collision avoidance systems.

Results of adopting this strategy have shown steady progress in reducing LIFE events over the previous 2 years, Williams (2012) reports. One reason the process has succeeded is that senior management views fatalities and fatality potential on a personal, individualized level.

### *Controlling Sentinel Event Hazards*

Since 1970, 125 employees have died on the job across all business units at Kimberly-Clark Corp. (KCC) (Jacobi, 2012). From 1997 until 2009, KCC experienced an average of two fatal injuries per year, leading it to embark on a journey to reduce the number of fatalities.

A primary KCC message is that prevention of fatalities requires some process for predicting their occurrence (Jacobi, 2012). An organization cannot identify the characteristics and causes of fatal events until it measures and trends loss incidents that, while not resulting in a fatality, could have. The first key realization is that data analysis suggests that fatal and near-fatal events at KCC can be classified into priority groups (called sentinel event hazards) with predictive power. Based on an analysis of fatal and near-fatal events from 1999 to 2008, KCC identified and categorized the following sentinel event hazards:

- contact with energy equipment (26.2%);
- transportation (road) (16.7%);
- lift-truck events (14.3%);
- falls (14.3%);
- fires and explosions (9.5%);
- electrical contact (arc potential) (7.1%);
- confined space operation (7.1%);
- falling objects (4.8%).

The second key realization is that addressing fatalities is a different problem set and requires a different approach (Jacobi, 2012). The company recognizes that fatality elimination is a separate but parallel effort to injury elimination. This approach is based on the research and publications of Manuele (2008) and others who suggest that efforts to reduce incidents and using traditional measures of severity do not address issues leading to death.

KCC is pursuing a dual-path strategy for prevention based on risk assessment and mitigation (Figure 3, p. 44). For low-severity exposure, risk assessment is a function of severity and experience-based likelihood; risk mitigation steps can be selected from the low to middle order from the control hierarchy. For likely precursors to FSIs, risk assessment is a function of severity and control-based likelihood; risk mitigation should involve LOP selected from the upper levels of the control hierarchy.

KCC's fatality prevention structure (Figure 5, p. 48) has as its foundation a code of conduct, global SH&E policy and a safety management system. From this structure, the following activities are directed to achieve zero injuries and fatalities: applying learnings from failures in safety systems and processes; mitigating recognized hazards through adherence to robust internal standards; and building SH&E capability through education and practical training, including global rollout of employee and leadership-specific sentinel event hazard recognition training.

A part of the implementation strategy is to conduct sentinel event training pilots for all business units and to revise its safety management system. This entailed revising key safety performance standards that affect control of sentinel event hazards; a refocused scope of global management system assessments on these performance standards; and embracing sentinel event reporting (e.g., KCC has a dedicated input interface as part of global safety reporting process).

According to Jacobi (2012), a key strategy involves communications such as global deployment of e-newsletters, mini-posters and hazard bulletins for eight sentinel event hazard categories. Other communication essentials are CEO and executive line of sight on measureable objectives, a dedicated intranet (SharePoint) site for tools (solutions), a web-based reporting interface with database used for trends, and a global communications plan linked to message branding. From July 2009 to the date of this writing is the longest period in more than 40 years without an employee or contractor fatality in a KCC manufacturing facility or distribution center.

## Best Practices Breakout Sessions

### *Leadership & Organizational Attributes*

The first best practice focuses on leadership involvement in serious injury/fatality investigations and their follow-ups leading to the implementation of corrective and preventive actions. In this case, it entails a team process. A root-cause analysis incident investigation begins immediately; the executive review team visits site within 2 weeks of incident; the team reviews completed investigation report, as well as recommended interim and long-term corrective actions; the team determines application to other lines of business within the company; the team develops communications plan for sharing lessons learned; the team conducts periodic reviews of status of corrective actions with the business unit executive; and a senior executive (e.g., EVP, COO, CEO) visits the site of the event initially and 6 months after to increase active, visible leadership.

Another best practice involves reducing risk through pretask hazard assessments/prejob briefs, in which senior management takes an active role in high-risk area management. By taking a few minutes before performing tasks, potential hazards are identified and steps necessary for avoiding them are outlined. Pretask hazard assessments increase safety awareness, thus decreasing operational risk.

Here's the typical process:

1) Before performing work, supervisors and workers meet to discuss the assigned task, its objectives and its hazards to clearly understand what to accomplish and what to avoid.

2) The briefing is a structured, risk-based review of the work activity from a human performance perspective to enhance workers' situational awareness (mental model) before they start to work. A pretask hazard assessment/brief provides the opportunity to ensure understanding of the task's scope, limits, precautions, hazards and responsibilities. It also provides a forum to ask questions and raise concerns, and to use operating experience to identify error precursors and flawed defenses.

Another best practice involves leadership thinking outside the box and emphasizes several factors: 1) integrating safety/leadership in engineering and business curricula; 2) integrating safety in the strategic decision-making planning processes; 3) preserving corporate memory; 4) allocating safety capital; and 5) using risk tolerance screening.

Improving management systems is another best practice. Specifically, this entails using the strength-of-defense matrix (e.g., prevention through design, engineering controls, administrative/procedural controls, administrative/behavioral controls) to assess and manage risk.

In addition, the SH&E profession needs to identify a new set of metrics or measurements relevant to FSI prevention. These metrics include: 1) measuring precursors, such as employees observing the risk, and using potential severity incident rates (whereby incidents are ranked based on their potential for ending up as a serious event in the future); 2) measuring engagement; 3) classifying risks; 4) using raw numbers, not the rates; and 5) assessing wellness indicators. These metrics differ from traditional lagging indicators, preventive action tracking and serious event focus, including fatality assessments.

### *Developing a Risk Profile*

In this context, a risk profile is associated with an organization's exposure to FSIs. Risk profiles should be determined by applying valid and reliable methods (e.g., measuring FSI potential risk, not risk of minor injuries, lost-time injuries) and techniques (e.g., providing consistent results if applied by multiple people at the same time and place). Risk profiles are determined at the site, process, task and individual levels.

Let's highlight five best practices. The first deals with evaluating the quality of management of change processes, particularly for situations involving high-risk work systems, settings and activities. Since innovation is fundamental to developing new technologies, products and processes that sustain business growth, the addition of new technologies or changes to familiar core business manufacturing operations often introduces new or unfamiliar hazards. Process change must be managed to control this risk.

A procedural checklist for risk management is another best practice in use. It is important to evaluate the quality of such checklists and compliance with their use in the execution of both routine and complex high-risk procedures and tasks.

Developing and consistently applying standardized, valid and reliable quantitative tools for routine assessment of organizational exposure to FSIs at the site, process and task levels is also considered a best practice. The tool incorporates input from all major stakeholders as well as specialized external expertise as appropriate.

The processes covered provide useful means of assessing risk profile pre- and postintervention (e.g., introduction of controls), and reflecting severity potential with and without controls. Initial risk is assessed assuming no controls are present. Potential risk is assessed assuming all listed controls are in place. The difference between these assessments indicates the effectiveness of risk reduction (helpful in communicating the importance of controls to employees and useful as an audit tool). Contractors should be required to implement similar procedures.

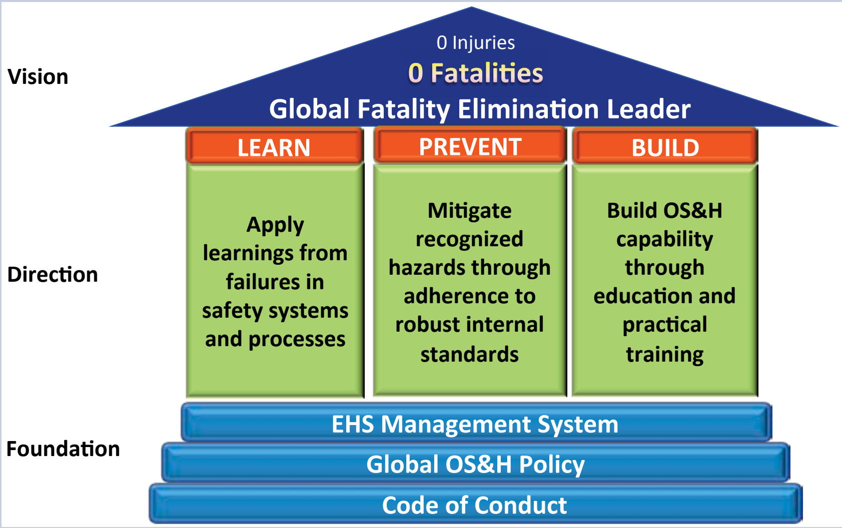
Some organizations apply personality inventory methods for workers involved in high-risk work processes. This provides a basis for coaching decision-making strategies appropriate to the level of potential risk. One assessment tool being used generates a safety insight report. This report inventories a worker's characteristics along a continuum related to reasoning (open-minded vs. cautious; taking chances vs. being conservative; analytical vs. intuitive), emotion (emotional vs. calm; overly confident vs. coachable; impatient vs. patient), and personality (spontaneous vs. deliberate; expedient vs. rule oriented; distractible vs. focused; impulsive vs. detailed).

The basis of inventorying reasoning, emotional and personality characteristics is that they influence behaviors. Related to this practice is the idea to develop and apply methods for determining cognitive and physical capabilities of individuals assigned to perform high-risk procedures and tasks. An organization would then reassign workers whose capabilities do not fit high-risk task requirements.

One other best practice involves the development and reinforcement of the use of real-time hazard assessment reporting and rating forms. An example is the HIRAC-lite approach used for nonroutine or infrequent tasks. A checklist, with color-coded (red/yellow/green questions to identify hazards and controls, is provided on a pocket card for use on the job site.


**To prevent FSIs, an organization must look at all of its incidents and assess their potential for leading to FSIs.**

**Figure 5**
## Fatality Prevention Structure




***Note.** Adapted from "Best Practices Showcase: Introducing a Global Fatality Prevention Strategy—Progress to Date, Kimberly-Clark," by D. Jacobi, 2012, presentation at Fatality Prevention Forum 2012, Coraopolis, PA, USA.*

**KCC's fatality prevention structure has as its foundation a code of conduct, global SH&E policy and a safety management system. From this structure, many other activities are pursued to achieve zero injuries and fatalities.**

### *Effective Risk Assessment Methodologies*

An organization must address inherent risk at various stages of work planning and execution. This can be achieved using three different approaches:

1) systems-based approach that requires the organization to assess and prioritize its safety management system on an ongoing basis;

2) hazard-based approach that begins with the hazardous characteristics of the materials, environment or work site, considering the possible activities that may affect them and the consequences;

3) task-based approach that begins with a job, breaks it into specific tasks, identifies associated hazards, then assesses the risks.

During this breakout session, 16 best practices were shared. Several of them adopt and/or adapt a traditional risk matrix to qualitatively and/or quantitatively assess risk level as described in Appendix F of ANSI/AIHA/ASSE Z10-2012, Occupational Health and Safety Management Systems. A common element throughout the best practices is a high level of employee involvement in assessing risk.

Five practices identified to be best overall in addressing risk at the systems, hazard or task level had several common characteristics:

1) an internal system to communicate lessons learned across their organizations;

2) status tracking of outstanding corrective or preventive actions as a result of risk assessment activities;

3) targeted training being demanded;

4) high level of management/labor cooperation;

5) employee participation;

6) risk assessment authority being delegated to the appropriate level of management to ensure process completion and success.

Most participants recognized that many of these best practices lack an effective tool for worker/supervisor/planner risk assessment at the critical step level. Risk assessments typically are conducted at the system, hazard and task level, but rarely at the specific critical step:

systems → hazard → task → critical step

A critical step is the unrecoverable step in a task; if it fails, an FSI may result.

### *Managing the Contractor/Contracted Services Risk*

Several best practices aim to expand contractors' abilities to assess the risk they bring to a host employer's site. It is also noted that the prequalification process does not always lead to selection of the best contractor due to the 1) need to select less-than-perfect vendors; 2) limited vendor pool; or 3) no choice on vendor selection. The knowledge/awareness gap places both a contractor's and an employer's workers at risk for FSIs since many contractors perform work that occurs during nonroutine operations or conduct high-risk tasks that a host employer's personnel are not qualified or do not wish to perform.

Some companies use tools that require contractors to perform a risk assessment before starting a job task in order to increase contractors' level of risk perception. Others believe a host employer should use contract mechanisms to manage contractor risk. The contract can specify controls that flow directly from the scope of work. Most believe it is also essential to monitor contractors while on site, since highest risk is present during work.

Several methods can be used to identify, assess, mitigate or eliminate the risk of fatal and life-altering injuries. These include a process for mentoring deficient contractors so that they can continue to be hired. This is essential in environments where the contractor pool is limited or in countries where a host employer may have no say in contractor selection. In addition, some are empowering employees to take responsibility for monitoring contractors while on site and providing methods for them to report unsafe practices and conditions to a contractor or host employer manager for correction rather than allowing the behavior or condition to continue. Another practice involves in-person visits by senior management to convey a strong message about contractor performance expectations.

Due to the lack of consistent control measures to manage known high-risk activities, some of which are known to result in fatalities, another approach is to standardize required controls for both employees and contractors who perform tasks within the scope of a global safe-permit-to-work program.

### *Effective Control for High-Risk Tasks*

Four of the top five best practices for controlling high-risk tasks utilize a risk assessment matrix, color-coding (red/yellow/green), and a checklist or hazard pictogram methodology to address potential human performance issues specific to a worker's assigned task. Frontline employees are often involved in the internal development of the prejob hazard recognition and evaluation tools. For each best practice that addresses the issue of worker risk recognition and evaluation, training is mandatory to ensure that workers understand they have authority to stop any job recognized to be unsafe.

None of the best practices specifically addresses the process of identifying and evaluating the critical task (unrecoverable step) in a job process, which if it fails has a high probability to result in a serious injury or fatality. Effective risk assessment methodologies could be developed to help work planners, schedulers, managers, supervisors, crew leaders and workers to identify the critical step(s) in a job packet and the high-potential/high-severity hazard(s) associated with the critical step(s). Effective risk assessment methodologies would evaluate the hazard, then eliminate or control the risk at an acceptable level.

### Conclusion

The pressing issue for many industries is that while overall OSHA injury and illness rates have dropped dramatically in recent years, FSIs have not experienced a similar decline. To address this dilemma, several themes were common among the presentations, best practice showcases and breakout sessions. The major theme was that to prevent FSIs, an organization must look at all of its incidents and assess their potential for leading to FSIs. At this forum, many presenters and organizations advocated tracking potential FSIs as an important new performance measure. This measure has both lagging and leading characteristics.

Not all incidents are equal in their FSI potential, and it appears that reducing minor incidents will not necessarily reduce serious and fatal incidents proportionately. Thus, the traditional Heinrich model and supporting principles have been determined to be descriptive, but not predictive, in nature. Once potential FSIs are identified, an organization can determine classes/characteristics of activities or situations associated with these potential FSIs, and investigate mitigation options. These classes/characteristics are precursors to FSIs and must be aggressively managed.

In terms of risk assessment and mitigation, a dual-track prevention strategy is proposed: one track for less-serious personal safety hazards (low-severity exposure) and another track for hazards with potential to cause serious injury and death. For low-severity exposure, risk assessment would be a function of severity and experience-based likelihood; risk mitigation steps would then be selected from the low to middle order of the control hierarchy. For likely precursors to fatal or serious injury, risk assessment would be a function of severity and control-based likelihood; risk mitigation would involve LOP selected from the upper levels of the control hierarchy.

It also appears that management of risk associated with FSI precursors must occur at the task level; individual tasks must be analyzed and controlled for their FSI potential. As a part of this analysis, critical steps associated with these tasks must be understood and controlled. Additionally, employee engagement is critical to identify and manage precursors (e.g., unmitigated high-risk situations, high-risk activities) that lead to high potential events that lead to negative outcomes. Equally important is senior management's ability to see the specifics behind the typical rates reviewed at high corporate levels—that real people comprise these rates, each with a different background story that needs to be heard and addressed.

Several gaps in current knowledge and practice require future research and discussion:

1) implementing a management system specifically for FSI;

2) defining and effectively using FSI leading indicators;

3) incorporating human factors (such as error proofing, literacy, training and qualifications, and fitness for duty) into management systems;

4) using safety considerations in strategic-level decision making;

5) making the critical step the next logical progression in the risk assessment process. **PS**

## For More Information

Find more information about the 2012 Fatality Prevention Forum, including PowerPoint files for all of the presentations and descriptions of best practices, at **www.iup.edu/page.aspx?id=128336**.

Additional related information on the human performance approach to managing organizational and human error can be found in Human Performance Tools: Engaging Workers as the Best Defense Against Errors & Error Precursors, by J.K. Wachter & P.L. Yorio, *Professional Safety*, February 2013, pp. 54-64.

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