# Major
# Risk

## Moving From Symptoms to Systems Thinking

### By James Loud

**IN BRIEF**
• The U.S. is suffering high incidence of catastrophic incidents and worker fatalities despite lower incident rates overall.
• Traditional worker-focused tactics and zero goals are not protecting against more serious incidents.
• Major risk is an organizational problem, not a personal problem.
• The safety practice must move from symptoms thinking to systems thinking to effectively address major risk and sustainable safety.

**T**he early industrial revolution was hard on U.S. workers. In 1912, some estimates for work-related fatalities totaled more than 20,000, or roughly four times more than occur today. Despite the appearance of improvement, the country's fatality rate has remained relatively flat for years. The 4,679 fatalities recorded in 2014 were the highest since 2011 (BLS, 2015), while incident rates overall have dropped significantly. The U.S. fatality rate is now considerably higher than many developed countries: three times higher than that of the U.K. (Mendel-off & Staetsky, 2013). Concurrently, the average cost of a workers' compensation claim has increased significantly (Manuele, 2008).

Is the safety practice overemphasizing personal injury incident rates at the expense of less frequent but more serious incidents? Is the relentless emphasis on ever-lower numbers and zero goals suppressing incident reporting and leading OSH professionals to manage the numbers rather than managing safety holistically? Is the focus on worker behavior keeping us from recognizing and acting on more fundamental root causes? This article addresses these questions, describes how the profession reached this point, and presents a more productive path forward.

Three widely publicized tragedies are painful reminders of the need for a new look at how to deal with serious risk and safety in general.

### Texas City Refinery

Immediately prior to the 2005 Texas City refinery explosion that killed 15 and seriously injured nearly 200 others, the BP facility's reportable incident rate was at an all-time low and was just one-third of that for the refinery industry (Hopkins, 2010). The refinery had received numerous internal safety awards and increased bonus pay as a result. Many of the workers killed in the explosion had just returned to their workstations after attending a luncheon celebrating their "excellent" safety record (CSB Investigation Findings, 2012).

Subsequent incident investigations, however, found widespread and longstanding safety weaknesses including unworkable and unfollowed procedures, deferred maintenance on safety-critical equipment, a tolerance for production to trump safety and "a culture of blindness to major risk" (Hopkins, 2010, p. 139). The incident resulted in record OSHA fines and the termination of six workers and four facility managers (Hopkins, 2010).

### Deepwater Horizon

Before the *Deepwater Horizon* explosion that killed 11 and triggered the largest accidental oil spill in

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history, the platform had experienced 7 years without a lost-time injury (Hopkins, 2012). BP, the platform owner, and Transocean, the platform operator, had also received 15 previous safety awards (CSB Investigation Findings, 2012). Ironically, several executives from both BP and Transocean were on board the day of the explosion to congratulate the crew on its outstanding safety record (Hopkins, 2012).

The final incident report found nothing to celebrate, however. "These failures . . . appear to be deeply rooted in a multidecade history of organizational malfunction" (DHSG, 2011, p. 5). The associated fines and compensation will cost BP more than $50 billion and have forced the company to sell off more than $40 billion in assets (A costly mistake, 2015).

### Laporte, TX

DuPont has long been noted and praised for its exceedingly low incident rates. In 2013, the company was awarded National Safety Council's (NSC) top safety award and praised for its commitment to ESH. In November 2014, four DuPont employees at the company's LaPorte, TX, plant were killed via chemical exposure. The subsequent incident investigation prompted OSHA's David Michaels to state, "the four preventable deaths and the very serious hazards we uncovered at this facility are evidence of a failed safety program" and "a broken safety culture" (Olsen, 2015). As a result of the investigation and previous safety lapses, DuPont was later placed in OSHA's severe violator enforcement program, which focuses on "recalcitrant employers who demonstrate indifference to the health and safety of their employees" (OSHA, 2013).

### The Common Link

These events are merely examples. What links them is the serious nature of the incidents and the mistaken belief that operations were truly safe prior to disaster. Although these catastrophic incidents involved considerably different operations and hazards, the organizations involved share several attributes:

1) All had significantly lower incident rates than most companies in their industry.

2) All had received internal and external recognition for their safety performance.

3) All employed worker-focused behavioral safety programs.

4) All failed to deal adequately with long-standing risk factors, resulting in catastrophic losses of human life, financial resources and organizational credibility.

Unfortunately these examples are not isolated. It is increasingly evident that despite lower incident rates overall, the U.S. is doing an inadequate job of preventing serious incidents and fatalities.

### How Did We Get Here?

Three pioneers in management, psychology and safety have had, and continue to have, a profound influence on the safety profession.

#### Frederick Taylor

Engineer Frederick Taylor became famous for his principles of scientific management and time motion studies in the early 1900s. Taylor believed that it was management's responsibility to scientifically study the work and devise the "rules, laws and formulae" necessary to perform that work in the most efficient manner possible. The worker would receive written instructions detailing what was to be accomplished, the means to accomplish it and the exact time allocated to accomplish it. It was the worker's job to follow those requirements exactly (Taylor, 1911/1998, pp. 15-17).

Although Taylor believed workers were inherently lazy, he was convinced they would produce optimum work if told exactly what to do and compensated more as a result, as long as they followed the rules. Taylor's theory was to train each worker so that "he continually and habitually works in accordance with scientific laws, which have been developed by someone else" and that "every single act of every workman can be reduced to a science" (Taylor, 1911/1998).

Taylor died more than a century ago, but his mechanistic ideas that workers should perform as compliant extensions of ideal processes live on. Command-and-control management practices, rigid rule enforcement, zero-tolerance policies and the presumed ability to pinpoint all safety-relevant behaviors for scientific modification owe much to Taylor's writings.

#### B.F. Skinner

B.F. Skinner, American psychologist, behaviorist and author, created the concept of operant conditioning, which contends that all behavior is determined primarily by positive and negative reinforcement. Skinner questioned even the existence of free will. "The hypothesis that man is not free is essential to the application of scientific method to the study of human behavior" (Skinner, 1953, p. 447). Although virtually all of Skinner's theories emanated from his experiments coaxing food-deprived rats and pigeons to press levers and disks for food, he contended that these operant conditioning principles applied neatly to humans as well.

Skinner was convinced that a utopian society was attainable if only mankind would embrace his behaviorist approach. His novel, *Walden Two*, described such a fictional community. Skinner further theorized that human behavior could be shaped "as a sculptor shapes a lump of clay" (Skinner, 1953, p. 91). His views on human behavior were highly controversial and remain so.

# Heinrich's Incident Pyramid: But Is It Valid?

1 major
injury

29 minor
injuries

300 incidents
(near-hits)
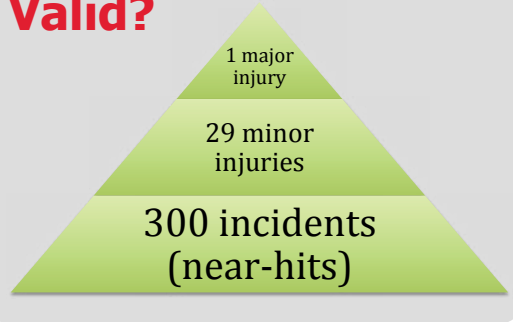
*Herbert William Heinrich*

Herbert William Heinrich, a manager with Travelers Insurance Co., published the highly influential book, *Industrial Accident Prevention: A Scientific Approach*, in 1931. The book's best-known theories are based on Heinrich's review of supervisor-generated incident reports from the 1920s. His research claimed that 88% of all incidents are the result of unsafe acts, 10% are due to unsafe conditions and 2% are unavoidable. Heinrich's research also produced what is known as the incident triangle or pyramid (Figure 1). The pyramid purports to show that for every 330 incidents there will be 300 that do not result in an injury, 29 that result in minor injuries and one that results in a major injury (Heinrich, 1931).

The safety community has argued about Heinrich's theories for more than 50 years. In general, however, safety professionals accepted, and largely continue to accept, Heinrich's now 80-year-old research. His theories of incident causation and ratios are entrenched in the safety literature and, along with Skinner's work, have served as a basis for worker observation programs for at least 25 years (BLR, 2009; Hopkins, 2010). For example, a 2012 poll of safety professionals found that 86% believed Heinrich's theories on workplace incidents, including the incident triangle and unsafe acts ratio, were either completely or somewhat valid (NSC, 2011).

Taylor, Skinner and Heinrich all saw operational success as principally a question of controlling the individual. Those views remain active in the safety profession and have resulted in myriad worker-focused tactics and programs (e.g., incentives, awareness programs, safety games, behavior-based safety). These tactics often come with highly seductive claims, such as promises to reduce incidents 40% to 70% in the first year, zero incidents or their ability to make safety automatic.

Before adopting such programs, however, one should recognize that any tactic that pays additional attention to safety, from rigid rule enforcement to safety games, is likely to produce results, at least in the short term. But correlation does not neces-

sarily indicate cause, nor do short-term injury rate improvements guarantee improved safety overall.

In addition, many of these worker modification efforts require an extremely high expenditure of finite safety resources, both to implement and sustain. For example, a typical behavior-based safety program for a large company can cost hundreds of thousands of dollars just to implement (Turnbeaugh, 2010). Despite the investment, many companies find it difficult to sustain these programs over time and as many as 70% fail, resulting in billions of dollars in lost time and revenues (Pounds, 2001).

## So What Is the Problem?

The world has moved on but safety practice, especially with regard to controlling catastrophic events and fatalities, has stayed behind. Work and workers have changed dramatically in the U.S. since the theories of Taylor, Skinner and Heinrich were introduced. Assembly lines, mindless repetitive work and even long-term employment with the same company are increasingly rare. Workplaces are more dynamic and complex than ever and this trend will likely continue. Today's workers are neither Taylor's cogs in a machine nor Skinner's "lumps of clay." Nor, as documented in the following discussion, are Heinrich's incident cause and pyramid theories supported by current research. Progressive companies view employees more as assets to engage than liabilities to control. But old habits and safety traditions die hard.

To better understand this problem, let's first address several prevalent misconceptions derived from Taylor, Skinner and Heinrich.

*Misconception No. 1*
Unsafe acts are the principal cause of incidents and minor injuries and are precursors to more serious incidents.

Not content with Heinrich's 88% figure, many safety professionals have assumed even higher unsafe act figures (up to 96%) as principal incident causes. Ascribing incidents to worker shortcomings is a temptingly simplistic way to divert attention from the more complex and often embarrassing reality of organizational deficiencies. Unfortunately, management is often content to focus on "getting workers to behave" as opposed to dealing with more deep-seated organizational issues (Smith, 2008). Confronting organizational deficiencies could indicate that the company and its management, not just the workers, need to do something differently.

As Petersen (1978) said nearly 40 years ago, an unsafe act may be a proximate cause, but "invariably it is not the root cause" (p. 17). Rather, he and a growing number of those writing in safety today have contended that incidents are merely symptoms or effects of weaknesses in the management system (Dekker, 2006, p. 88; Deming, 2000; Petersen, 1978).

In addition, mounting evidence suggests that the relationship between minor injuries and major

incidents is tenuous at best. Several recent studies (Mattis & Nogan, 2012; RAND Corp., 2012) actually show higher construction fatality rates in states with lower overall incident rates and vice versa. Other studies have found little or no correlation between improving rates of minor injuries to the likelihood of serious injuries and fatalities (Mattis & Nogan, 2012).

Despite these findings, Heinrich's pyramid is still cited frequently in the safety literature and taught in many safety courses. Heinrich's theories are, however, increasingly seen as impediments to safety and a source of blindness to major risks (Hopkins, 2010). Nearly all that can be safely said about Heinrich's pyramid is that, in general, more minor injuries occur than do serious ones.

Despite well-documented and convincing arguments that unsafe acts are merely symptoms of systemic problems, controlling worker behavior remains central in much of the safety practice. A 2014 survey of safety professionals found that 85% of the more than 1,100 respondents believed personal factors and employee noncompliance were their biggest challenges (Lawton, 2014). Other contemporary surveys (Manuele, 2014; My Safety Sign, 2015) confirm that a considerable majority in the safety profession still views unsafe acts as its chief concern.

The pervasiveness of this safety-as-a-personal-problem view was recently underscored by the CEO of the 50,000-employee company awarded NSC's top safety award for 2015. The well-intended executive stated in an interview his conviction that "between 80% and 95% of incidents are caused by at-risk behavior" and that he tells his employees "all the time" that zero is achievable, and that he considers the number of worker-submitted behavior observation cards his leading safety performance indicator (NSC, 2015). Some, however, find this persistent allegiance to Heinrich's numbers a serious roadblock to safety progress (Hopkins, 2010; Manuele, 2014).

### Misconception No. 2
#### Controlling the worker is the essence of safety.

This Taylor- and Heinrich-inspired myth has been questioned by many, including the iconic management and quality legend, W. Edwards Deming (2000), whose book, *Out of the Crisis*, belongs on the bookshelf of every safety professional.

> The supposition is prevalent the world over that there would be no problems in production or service if only our production workers would do their jobs the way that they were taught. Pleasant dreams. The workers are handicapped by the system, and the system belongs to management. (p. 134)

Since many in safety still accept that essentially all incidents are the fault of workers behaving badly, it is not surprising that worker-focused approaches are so prevalent. While some of these tactics may add value, they can also divert attention and resources from systemic and interacting factors such as design and engineering, operational systems, production pressure, procedure and training adequacy, organizational cultural issues and other fundamental influences frequently implicated in workplace tragedies (Erickson, 2001; Manuele, 2008).

This is exactly what CSB found in its investigation of both the Texas City refinery and *Deepwater Horizon* tragedies, and the petroleum industry as a whole. According to investigators, these examples indicate that "the entire industry is focusing too narrowly on personal safety issues" and that doing so has led to "complacency on major hazards" (Associated Press, 2012). Given the stated beliefs of most safety professionals, it seems likely that these findings also apply to industry in general.

It is not the author's intent to debate the efficacy of every worker-focused program. Many varieties exist, some are better than others. No one should believe, however, that they have done or learned much about controlling catastrophic incidents by pinpointing readily observable and repetitive critical behaviors, placing them on a checklist, then attempting to reinforce them from at-risk to safe. What you look for truly is what you find, and likely all you find.

### Misconception No. 3
#### Compliance equals safety.

Safety is more than compliance. Zebroski (1991), a nuclear safety analyst, performed a detailed analysis of four highly publicized tragedies: The *Piper Alpha* oil rig fire; *Challenger* space shuttle explosion; Bhopal toxic gas leak; and Chernobyl nuclear explosion. According to Zebroski, believing that rule compliance was enough to ensure safety was a "principal cause" of man-made disasters such as Three Mile Island and Chernobyl. Compliance remains a principal goal for many companies, however, and it is instructive to review how such goals became so prevalent.

OSHA was enacted in 1970. Its abundant requirements were essentially adoptions of existing standards (e.g., ANSI) and, as a result, dealt largely with conditions. Everything from scaffold toe board dimensions to the design of toilet seats became the law of the land. New safety positions, such as compliance manager and compliance engineer, proliferated. Armed with their encyclopedic knowledge of safety requirements, many practitioners set out to enforce every safety detail in the Code of Federal Regulations and the company safety manual, regardless of their importance to safety (Loud, 2012).

Eventually, many companies became disillusioned with low-return OSHA compliance efforts, which were often accurately perceived as nitpicking. Many companies turned their attention back to compliance by the mid-1980s, however, this time the emphasis was on compliant workers rather than compliant conditions, which led to the prevalent emphasis on unsafe acts. These new safety tactics were aimed at changing behavior from unsafe (noncompliant) to safe (compliant) via positive and negative reinforcement (i.e., operant conditioning). Safety goals merely shifted from compliant conditions to compliant workers.

## Figure 2
## PDCA Cycle

Plan

Act/improve

Do work safely

Do

Check/study

However, a company should want and expect more than automatic thoughtless compliance. The company should not expect workers to check their brains at the gate. Neither should firms want workers to feel like puppets, powerless over their assigned work. Undoubtedly, following the rules is important. But the author has come to view compliance as a by-product (not a driver) of organizations that make safety a value. Better to develop workers with a questioning attitude and a commitment to actively engage in the continuous improvement of what are always imperfect and dynamic systems. Compliance is a low bar; it does not provide significant protection from the complex interactions and the infinite number of factors that can contribute to catastrophic incidents.

### Misconception No. 4
Low (or zero) personal injury rates indicate safety.

This myth owes much to the residual influence of Heinrich's pyramid. The three catastrophes discussed along with current research demonstrate the fallacy of this pervasive belief, at least related to serious incidents. There are, of course, many ways to obtain low, or even zero, incident rates, at least temporarily:

•Do no work. All work involves an element of risk. If a company is genuinely devoted to zero injuries, the only choice is to do no work.

•Manipulate the data. Was that injury really recordable or just a first-aid case? Can we make the injured party a contractor? If we no longer employ the worker, does the incident still count?

•Do not report incidents. This can be, and often is, accomplished via employee intimidation. No employee wants to be the one who blows the zero goal, costs his/her boss a bonus or ruins the potential for incentive awards. The organization can also simply decide not to report, a practice OSHA finds increasingly common. General Motors recently

dropped the use of incident metrics altogether, as it recognizes the tendency of these measures to suppress reporting and their general lack of value to safety (Hessman, 2015).

•Get lucky. Unfortunately, good luck is not sustainable.

Even if you trust the numbers, what do they really tell you? As noted, evidence is scant that low overall incident rates have a significant connection to more serious incidents. It would be unwise not to track injuries, but when low rates or zero are the goal, this opens the door to fudged numbers and missed learning opportunities, as well as potentially dangerous and unwarranted complacency.

### Beyond the Symptoms

The top manager of a safety-award-winning company recently stated that for him, "safety is not a strategy" (NSC, 2015). No doubt he meant that safety had some higher calling and certainly was not implying that safety did not matter to him. But would this CEO have said that sales growth, production, market share or any other of his business priorities lacked a management strategy? Does safety not warrant a strategy as well?

The stubbornly high incidence of serious incidents and fatalities indicates that a different, more strategic and sustainable approach is needed. Even many behavioral consultants now acknowledge that the "different causes" of serious incidents are inadequately addressed by current safety practices (Mangan, 2015; Martin, 2013; Martin, 2014; Martin & Black, 2015). A study by Behavioral Science Technology also concluded that factors such as lax procedures, missing controls, bad design and other issues frequently leading to serious incidents are not well addressed by typical safety efforts including behavioral observations (Johnson, 2011).

Risk exists in an interactive system, much of which is beyond workers' influence. Risk and reliable performance are, therefore, systems issues, not personal issues (Weick & Sutcliffe, 2007). Bringing risk to an acceptable level begins with analyzing the work, not just the personal acts of the worker.

Adopting a management strategy to continuously improve system and cultural influences addresses both minor and major risk because this method deals with root causes rather than symptoms (i.e., unsafe acts). An excellent guide (among others) for such an approach is ANSI/ASSE Z10, Occupational Health and Safety Management Systems. Z10 is based on Deming's plan-do-check-act (PDCA) cycle with a goal of continuous improvement (Figure 2). Z10 is not a cookie-cutter formula for instant success. Instead it offers practical guidance to develop an effective safety management system that recognizes that the vast majority of safety improvement opportunities are realized by addressing the system, not people (ANSI/ASSE, 2012, p. 34).

A proper discussion of safety management systems would require a separate article. But, every effective safety system should include:

•a plan that establishes goals, objectives and actions for every organizational level and function

(e.g., human resources, purchasing, maintenance) to meet those goals and objectives, and associated metrics to help gage success;

•a commitment to execute the actions called for in the plan;

•a check step that uses metric data and various feedback sources to hold the organization accountable for its commitments and to evaluate its overall effectiveness;

•an act step that makes adjustments to the system based on the conclusions from the check step. The act step is what makes systems dynamic (always evolving) and drives continuous improvement.

Unintegrated collections of static tactics, requirements and programs are often called systems and may reflect one-time fixes, but generally do not systematically address the underlying root causes of organizational deficiencies as envisioned by safety management systems such as Z10 (ANSI/ASSE, 2012).

It is time for OSH professionals to ask themselves whether person-focused, rather than system-focused, tactics contribute to or impede the organizational change necessary to address all risk, not merely employee behavior. Systems thinking is needed to unearth latent and systemic risk factors commonly associated with serious incidents and fatalities. Until OSH professionals and their employers begin looking at safety as a strategic integrated system rather than a compendium of worker-focused tactics and low-order administrative controls, serious incident rates will likely not improve. Manuele (2008) contends that "as knowledge has evolved on how accidents occur . . . the emphasis is now correctly placed on improving the work system, rather than on worker behavior. Heinrich's premises are not compatible with current thinking" (p. 52).

## What Can the Safety Professional Do?

Although many ways exist for a safety professional to help his/her company move to a more systems-based approach, the author views the following as fundamental:

**1) Become familiar with systems in general and safety management systems (e.g., Z10, ISO 45001) in particular.** Petersen (2001) says that since incidents, unsafe acts and unsafe conditions all demonstrate weaknesses in the system, safety professionals needed to become system evaluators. Those who do not have a good working knowledge of how systems and the PDCA cycle operate, or should operate, have some catching up to do. Deming's work is a great place to start.

**2) Recognize that low or zero personal injury rates do not, in themselves, protect against the likelihood of more serious incidents.** In addition to the problems noted, the effort needed to drive the most common and minor injuries to zero can deflect significant resources from more serious risk and safety overall. Resist the temptation of quick fixes promising instant or near-instant injury reductions. Quick fixes for sustainable safety simply do not exist.

**3) Move beyond single-event thinking that workers' unsafe acts are the principal cause of safety problems.** Controlling risk involves far more than controlling people. Systems thinking requires looking at safety and risk holistically, not merely at symptoms in isolation (Dekker, 2011, p. 34). Attempting to control or manipulate the workforce may achieve compliance (when someone is looking), but not the discretionary worker engagement needed for sustainable safety and continuous improvement. When workers lack any sense of autonomy and are treated as a problem to be controlled or fixed, they are more likely to behave in that manner (Schein, 2004).

**4) Search for opportunities to involve and engage the workforce in every aspect of the safety effort.** No one understands the work better than those who perform it. Applying that understanding can improve everything from training and procedure development to incident investigation. An important by-product of such engagement is the sense of ownership that facilitates worker buy-in. Worker engagement is a win-win.

**5) Promote strategic safety management.** Safety deserves and requires strategic management. Any improvement journey should begin with a thorough assessment of the starting point (the "as is") versus the destination (the "should be"). Competent safety professionals versed in root-cause analysis and assessment skills can make a major contribution here. Assessment criteria abound in the works of Petersen and Deming, and the guidance provided by current safety management system standards such as Z10 and ISO 45001 is recommended as well. Although safety is a management responsibility, many managers do not have a strategy for creating safety in their organizations, and really do not know what to do other than maintain traditional methods. The safety profession has a responsibility to help strategically guide them to a better place.

## Conclusion

Although enormous strides have been made in workplace safety since the industrial revolution, much of the safety effort today remains overly focused on symptoms and tactics to enforce, inspect or observe worker compliance. Many in the profession have oversimplified complex causation factors and put incident rates and personal behavior modification at the center of safety efforts. The pervasive belief that individual unsafe acts are the cause of virtually every incident has blinded many, not only to more serious risk, but also to any risk outside a simplistic view of causation.

The efforts to drive injury incident rates to zero and manipulate worker behavior have not fundamentally altered the root-cause issues that often lead to tragic consequences. Claims that by identifying, then modifying worker behavior we can somehow change attitudes and thus the organizational culture (McSween, 2003; Turnbeaugh, 2010) seem unproven. It is past time to recognize that continuous improvement is a more produc-

tive, proactive and comprehensive goal than low or zero injuries and compliant employees. Upon accepting this conclusion, OSH professionals can move toward more holistic and sustainable strategies that recognize safety and risk as system issues rather than personal problems. **PS**

**Major risk is an organizational problem, not a personal problem.**

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