The Challenge of Preventing Serious Injuries

A proposal for SH&E professionals

By Fred A. Manuele

THE FREQUENCY OF WORKER INJURIES is down, but serious injuries are more prominent within the entirety of the lost-worktime cases reported and average workers' compensation claims costs have risen at a remarkable rate. This trend suggests the need for SH&E professionals to study the characteristics of incidents resulting in serious injury, particularly of the nature of work being performed and the job titles of injured personnel.

In *The Blame Machine: Why Human Error Causes Accidents,* Whittingham describes how disasters and serious accidents result from recurring but potentially avoidable human errors. He shows how such errors are preventable because they result from defective systems within a company. Based on analyses of several events, he identifies the common causes of human error and the typical system deficiencies that led to those errors. Those deficiencies were principally organizational, cultural, technical and management systems failures.

According to Whittingham, a "blame culture" exists in some organizations, whereby the focus of investigations of incidents that result in severe consequences is on individual human error, and the focus of corrective action taken is at that level rather than on the system that may have enabled the human error.

Early on, Whittingham says that many organizations—and sometimes entire industries—are unwilling to look closely into error-provocative system faults. He stresses that putting responsibility for the incident on what an individual did/did not do results in simplistic causal factor determination (Whittingham). Many SH&E professionals should think about this when dealing with their clients.

In organizations reluctant to explore systemic causal factors, the incident investigation stops after addressing the individual human error—the unsafe act. Thus, a more-thorough investigation that looks into the true root-causal factors is avoided. If an organization chooses to reduce the probability of serious injuries, safety management systems must be in place to:

- anticipate and take corrective action on hazards that may have serious injury potential;
- ensure in-depth reviews of root-causal factors for incidents that result in serious injury;
- address organizational, operational, technical and cultural causal factors.

As practitioners study serious injury trending, they may find that a culture change is necessary to achieve desired goals.

Statistical Indicators

Data displaying the adverse progression for serious injuries and workers' compensation claims costs have been extracted from two sources—Bureau of Labor Statistics (BLS) and the National Council on Compensation Insurance (NCCI). It should be noted that the impact of serious injury trending over the last several years may differ considerably by industry. Statistics given here are derived from macro studies or may relate to specific industries. Practitioners should make their own studies of serious injury trending in the entities to which they provide counsel so that the conclusions they draw and the recommendations they make have a sound, realistic base.

Bureau of Labor Statistics

For many years, BLS has issued reports titled "Lost-Worktime Injuries and Illnesses: Characteristics and Resulting Time Away from Work." Data in Tables 1 and 2 and Figure 1 were taken from Table 10 (Percent Distribution of Nonfatal Occupational Injuries and Illnesses Involving Days Away from Work) in those reports for the years 1995 through 2001. Table 10 shows the percentage of selected days-

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Table 1

Percentage of DAFW Cases, Numbers of Days, Private Industry

	1	2	3-5	6-10	11-20	21-30	31 or More
1995	16.9	13.4	20.9	13.4	11.3	6.2	17.9
2001	15.4	12.7	19.8	12.6	11.1	6.3	22.0
Change from 1995	-8.9	-5.2	-5.3	-6.0	-1.8	+1.6	+22.9

Source: BLS.

Abstract: *This article discusses the noteworthy and adverse progression over the past several years with respect to serious injuries and workers' compensation claims costs. The types of activities out of which many serious injuries occur are discussed, as are the results of studies on the characteristics of incidents resulting in severe injuries, significant conceptual barriers to serious injury prevention, and actions that SH&E practitioners can take to reduce serious injury potential. In addition, a procedure that SH&E professionals can use to analyze serious incident experience and determine what proposals should be made for improvements in safety management systems is provided.*

away-from-work (DAFW) categories as each category relates to the total number of DAFW cases reported in a given year (BLS).

From 1995 to 2001, several observations can be made with respect to the changes in the distribution of the total number of lost workday cases reported in each of those years:

- The decreases in the percentages for the first four DAFW categories listed are significant.
- For the 11-to-20 and the 21-to-30 DAFW categories, the decrease of 1.8% and the increase of 1.6% are not as significant.
- The 23% increase for the 31-or-more DAFW category is significant.

Table 2

Percentage of DAFW Cases, 31 or more DAFW

Year	Percent
1995	17.9
1996	18.5
1997	18.5
1998	19.1
1999	19.6
2000	21.0
2001	22.0
2002	23.4 (projected)
2003	25.0 (projected)

Displaying the Trending

To produce more specific trend data on the lost workday cases with 31 or more DAFW, several indicators were extracted from BLS reports. Table 2 shows percentage of cases involving 31 or more DAFW from 1995 to 2001, and projected for 2002 and 2003. Note that these projections are based on the statistical history for the years 1995 through 2001 and assume that the trending in those years will continue. Rules for reporting lost workday cases were revised for 2002 with respect to how DAFW are counted. Direct comparisons for that year and subsequent years cannot be made with data for previous years.

Alan Hoskin, manager of the statistics department at National Safety Council (NSC), agrees that this trending is statistically meaningful. Using the base data for the years 1995 to 2001, he produced the projected numbers shown in Table 2 through polynomial charting. (Polynomial: A mathematical expression consisting of the sum of a number of terms, each of which contains a constant and variables raised to a positive integral power.)

For 2002, the polynomial projection for lost workday cases with 31 or more DAFW is 23.4%. In the BLS report for the year 2002 (the last year for which data are available), the recording is 25.1%. Some of this difference could result from the change in reporting rules on how DAFW are counted. For 2003, the projection is 25.0% on the polynomial line.

Figure 1 displays the trending from 1995 to 2001 and a projection of the trending into 2002 and 2003. SH&E practitioners should consider what this display means for the operations with which they are involved.

Taken as a whole, BLS data on lost-worktime injuries and illnesses seem to track well with the statements made by NCCI indicating that the frequency of workers' compensation claims has declined, with the decline being most pronounced for smaller claims.

National Council on Compensation Insurance

According to a Jan. 7, 2004, NCCI news bulletin:

> On-the-job claim frequency for workers' compensation injuries continues to decline. Research shows that this decline has been most pronounced for smaller claims. However, medical and indemnity costs continue to rise. NCCI has reported significant increases in both the average indemnity and average medical cost of a claim over the last several years.
>
> Workers' compensation indemnity claims [increased] an average of 7.4% annually since 1996. Medical claim cost trends show double-digit increases the last two years. In 2001, medical severity increased by 12%, and in 2002, medical costs rose an additional 11% [NCCI(b)].

Mealy authored an extensive report for NCCI titled "State of the Line: Analysis of Workers' Compensation Results" in May 2004. Of several exhibits in that report, two are relevant here—Exhibit 11: The Rate of Change in Workers' Compensation Indemnity Claim Costs Has Accelerated Since 1995; and Exhibit 12: Workers' Compensation Medical Cost Trends Continue to Climb (Mealy).

Data in those two exhibits are for lost-time claims. The following computations were made for the years 1996 through 2002, with 1995 having a base of one: From January 1996 through December 2002, the average indemnity claim cost increased 66% while the medical claim cost increased 83%.

To determine how those cost increases related to economic inflation as a whole, the author used an inflation data calculator found at www.inflation

data.com to determine that (with 1995 having a base of one) the accumulated inflation for the U.S. economy from January 1996 through December 2002 was 17.2%. In those years, the increases in average workers' compensation indemnity and medical claim costs were at a factor of about 4.4 times inflation. That is significant and deserves attention—particularly if the trend continues.

Consider also the following excerpts from a Feb. 3, 2005, NCCI bulletin:

> Accident year 2003 frequency decreased about 4% from the level of 2002. This is the same rate of decline as the average over the prior four years. Indemnity severity for accident year 2003 increased by about 5%.
>
> The average annual increase for the years 1999 to 2002 is approximately 8%. Medical severity, however, continued to increase at a historically high rate. While the previous four years averaged 10% annual increases, accident year 2003 increased by 11% [NCCI(a)].

To summarize, overall, the frequency of worker injuries is down; serious injuries are more prominent within the entirety of the lost-worktime cases reported; and average workers' compensation claims costs have risen at a remarkable rate.

Actions to Be Taken

In light of recent developments, SH&E practitioners need to determine precisely how these data might apply to the operations to which they give counsel. It is likely that the increases in serious cases are not identical across all industries.

As a first step, SH&E practitioners should become aware of the content of the BLS's annual publication, "Lost-Worktime Injuries and Illness: Characteristics and Resulting Days Away from Work." It contains 15 tables that provide a great variety of data on the characteristics of lost-worktime injuries and illnesses—such as for occupations of the injured persons, nature of injury and illness, experience by industry, and events or exposures from which the injuries and illnesses derive.

Practitioners should also review incidents resulting in severe consequences in their entities so they can identify the types of activity that produce these incidents and the job titles of those involved.

Basis for This Proposal: Investigation Review

Based on a review of more than 1,000 incident investigation reports, the author's analyses reveal several key findings:

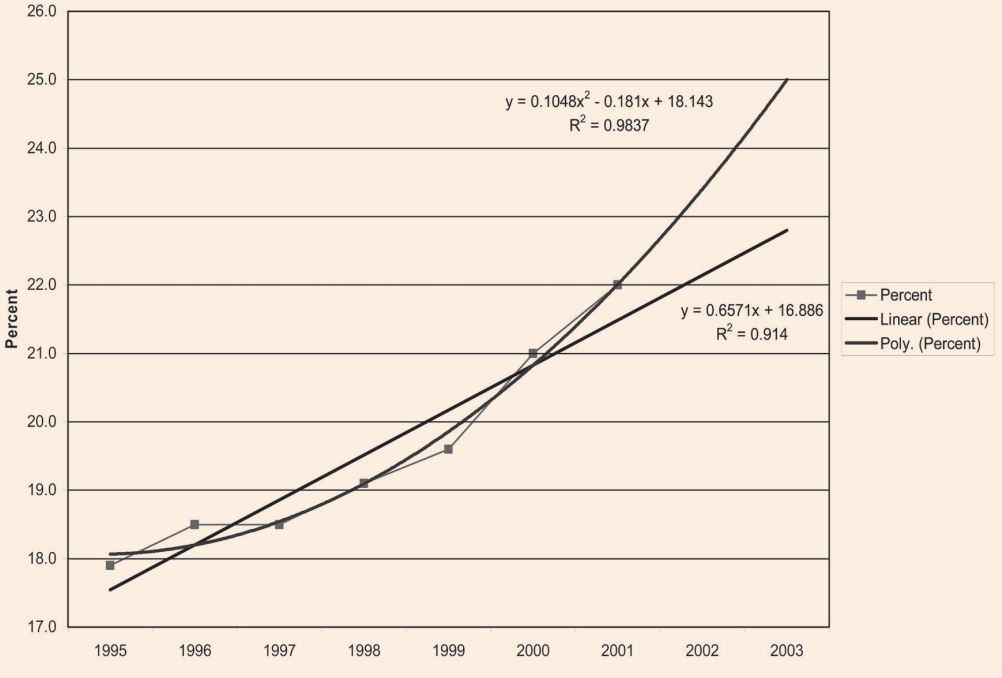
- A large proportion of incidents resulting in severe injury occur in unusual and nonroutine work, in nonproduction activities and where sources of high energy are present. They also occur in what can be called at-plant construction operations. (An example of at-plant construction: A motor that weighs 800 pounds and sits on a platform 15 feet above the floor needs to be replaced; the work will be performed by in-house personnel.)
- Causal factors for low-probability/high-consequence events are seldom represented in the analytical data on accidents that occur frequently (although some ergonomics-related incidents are the exception).
- Many incidents resulting in serious injury are unique and singular events, having multiple, complex causal factors that may have technical, operational systems, or cultural origins.

Petersen has made similar observations. He supports the view that severe injury potential needs special attention:

> If we study any mass data, we can readily see that the types of accidents that result in temporary total disabilities are different from the types of accidents resulting in permanent partial disabilities or in permanent total disabilities or fatalities.
>
> The causes are different. There are different

Figure 1

Percentage of DAFW Cases, 31 or More DAFW, Private Industry, 1995-2001



sets of circumstances surrounding severity. Thus, if we want to control serious injuries, we should try to predict where they will happen. Studies in recent years suggest that severe injuries are fairly predictable in certain situations. Some of those situations involve:

- unusual, nonroutine work;
- nonproduction activities;
- sources of high energy;
- certain construction situations (Petersen).

As noted, the causes and circumstances surrounding severity are different. SH&E practitioners should try to predict where serious injuries may occur since the occurrence of severe injuries is fairly predictable in certain types of work.

Since the characteristics of serious injuries and the types of activities and exposures in which many of them occur have been known for some time, one could question why they have not received more attention in the safety community. Two key barriers are addressed later in this article; they are related to these beliefs that have long permeated the practice of safety:

- Reducing incident frequency will equivalently reduce the occurrence of low probability/serious consequence events.
- Unsafe acts of workers are the principal causal factors for occupational incidents.

Support for the Proposal to Study Severe Injuries

A statistical history supports proposing that SH&E practitioners study the characteristics of incidents resulting in serious injury, particularly the nature of work being performed and the job titles of injured personnel.

UAW Data

At a workshop held in April 2004, Franklin Mirer, director of the United Auto Workers (UAW) health and safety department, said that over a period of 20 years, skilled trades personnel—about 20% of the UAW membership of about 700,000—had 41% of the fatalities. Skilled tradespeople are maintenance personnel, millwrights, tinsmiths, machinists, electricians and steamfitters; they are not production workers. Mostly, they perform nonroutine work, are exposed to sources of high energy and may perform at-plant construction. Hours worked during the period Mirer references are in the billions. These fatality numbers are statistically significant.

General Motors

In an article about culture change at General Motors, Simon and Frazee state:

> Statistics showed that 80% of all serious accidents at GM occurred among the skilled trades, not on the assembly line (Simon and Frazee). [According to one of the authors, for the article, serious meant life threatening.]

Liberty Mutual's 2003 Workplace Safety Index reads:

> A small percentage of workers' compensation claims continue to be responsible for the bulk of direct costs. In 2000, disabling workplace injuries were 18% of workers' compensation claims but 93% of direct costs (Liberty Mutual).

An article issued some 25 to 30 years ago by Employers Insurance Company of Wausau included data similar to that in the Liberty Mutual Index.

> A study showed that 86% of total injuries produced only 6% of total costs, while 14% of total injuries produced 94% of total costs.
>
> Here we can distinguish between the "trivial many" and the "vital few' (Employers of Wausau).

The report concludes, "It becomes readily apparent that the logical approach to effective loss control is to concentrate major efforts on the 'vital few.'"

That a small percentage of workers' compensation claims represent a very large proportion of total costs fits well with Pareto's Law, which is commonly referred to as the 20/80 rule and the law of the trivial many and the critical few. In a large statistical sampling, 20% of the units will represent 80% of the impact, as well as the opportunity for improvement. Spending a disproportionate amount of time on the 80%, the abundant literature on Pareto's Law shows, may achieve little return. Giving additional emphasis to the critical few is the theme of this article.

Another Study: Principle Business Operations Personnel vs. Ancillary Personnel

In February 2004, the author conducted a study to determine what percentage of lost workday cases with DAFW occurred to personnel engaged in a company's principle business operation (making a product or providing a service) and what percentage occurred to ancillary or support personnel.

The sample was small and the variations by company were considerable. Participants also provided OSHA incidence and lost workday case rates. Some of the companies with high OSHA rates had higher percentages of lost workday cases with DAFW involving workers engaged in the "principle business" than for ancillary workers. The opposite was true for companies where the OSHA rates were low for their industry classes.

Consider the possible significance of the following. The three largest companies that provided data had a total of 230,000 employees. Each company had an OSHA recordable rate below 0.5 and a lost workday case rate of less than 0.2. A composite of the data for those companies indicated that 74% of lost workday cases with DAFW occurred to ancillary and support personnel rather than to employees engaged in the principle business. Two safety directors asked to contribute data for the study said that the study was unnecessary since they believed that if incident frequency was reduced, severity potential would also be comparably reduced. That and another burdening premise need exploration.

Barriers to the Prevention of Serious Injuries

As noted, two beliefs in safety have long served as barriers to making the necessary inquiry into the

reality of design and engineering, operational systems and cultural causal factors for incidents that result in serious injury. Those beliefs are:

1) Reducing incident frequency will equivalently reduce the occurrence of low probability/serious consequence events.

2) Unsafe acts of workers are the principal causal factors for occupational incidents.

In a speech at the 2003 Behavioral Safety Now Conference, Liberty Mutual's James Johnson stated:

> I'm sure that have many of us have said at one time or another that frequency reduction will result in severity reduction. This popularly held belief is not necessarily true. If we do nothing different than we are doing today, these types of trends will continue (J. Johnson).

Consider those words. If SH&E professionals and their employers do nothing different than they are doing today, the adverse trending for serious injuries will continue. Frequency reduction does not necessarily produce equivalent severity reduction. Those statements are supported by statistics.

NSC Data

The following is extrapolated from *Injury Facts,* 2003 Edition.

> From 1973 to 2001, the occupational injury and illness rate for private industry dropped 50%—from 11.3 to 5.7. In the same period, the incidence rate for total lost workday cases decreased 18%—from 3.4 to 2.8 [NSC(b)].

Obviously, the reduction in the lost workday incidence rate did not equal the reduction in incident frequency. These data on injury trending are important in that they contravene the commonly held belief that efforts concentrated on reducing injury frequency will equivalently affect injury severity.

To hold with that belief, one must assume that the causal factors for incidents which occur frequently are the same as those for incidents that result in serious injury. This author's studies show that the causal factors for incidents resulting in severity are to a large extent different and that they are rarely found in the causal data on incidents which occur frequently.

The premise that workers' unsafe acts are the principal causal factors for occupational injuries must be addressed as well. Unfortunately, many SH&E practitioners have promoted safety management systems that focus extensively on what the worker does—meaning on the prevention of unsafe acts. Furthermore, some management personnel have been taught by those practitioners that the focus of their safety management systems should be principally on worker behavior.

Adopting that mindset results in the allocation of resources predominantly to the worker behavioral aspects of safety. This results in inadequate attention on systemic causal factors deriving from design and engineering shortcomings, the hazards in current operational procedures and the system of expected behavior that has developed over time.

Greater progress in the prevention of incidents resulting in serious injury will not occur as long as these two premises remain as barriers to determining the true causal factors of incidents.

Specifics for the Study Proposed

A study of incidents resulting in serious injury will not be time consuming. The data to be collected and analyzed should already exist or be easy to obtain. The following action outline can be modified to fit particular needs.

- Define the parameters for the incidents to be studied. For example, lost workday cases involving 21 or more days away from work; or lost workday cases involving 31 or more days away from work; or cases valued at $25,000 or more; or cases valued at $50,000 or more.
- Gather incident investigation and injury data related to the serious injury definition chosen for at least a three-year period.
- For each incident:
  1) Record the nature of the work being performed.
  2) Note the job titles of the injured personnel.
  3) Determine whether the injured persons were engaged in the entity's principal business or whether they were ancillary personnel.
  4) Identify the causal factors (e.g., design and engineering, operational system, cultural, organizational).
- Analyze and summarize the data to determine what modifications in safety management systems should be proposed.

If the money value of injuries and illnesses is to be used in selecting a severity category, the following information may be helpful. A major third-party administrator analyzed 280,000 workers' compensation claims that it managed in 2003. These are some of the results from a yet-to-be-published article based on that analysis:

- Three percent of claims were valued at $25,000 to $50,000; they represented 20% of total claims costs.
- Three percent of claims were valued over $50,000; they represented 52% of total claims costs.
- Six percent of claims valued at $25,000 or more produced 72% of total claims costs.

Incident Investigation

While it is suggested that an attempt be made to identify all causal factors for the incidents to be analyzed, SH&E practitioners should not be surprised to find incident investigation reports lacking in-depth causal factor determination.

As noted, the author has studied more than 1,000 incident investigation reports provided by corporate safety directors in large companies. The purpose

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was to assess the quality of the investigation systems in place. On a scale of 10, with 10 being best, some companies scored a 2. Causal factor determination was dismal, meaning that opportunities to readjust the focus of preventive efforts to the benefit of workers and employers were lost.

The *Columbia* Accident Investigation Board (CAIB) drew similar conclusions during its investigation of the *Columbia* space shuttle explosion. SH&E professionals should consider how these excerpts from CAIB's report relate to the incident investigation systems of the entities with which they are involved.

> Many accident investigations do not go far enough. They identify the technical cause of the accident, and then connect it to a variant of "operator error." But this is seldom the entire issue.
>
> When the determinations of the causal chain are limited to the technical flaw and individual failure, typically the actions taken to prevent a similar event in the future are also limited: fix the technical problem and replace or retrain the individual responsible. Putting these corrections in place leads to another mistake—the belief that the problem is solved.
>
> Too often, accident investigations blame a failure only on the last step in a complex process, when a more comprehensive understanding of that process could reveal that earlier steps might be equally or even more culpable.
>
> In this Board's opinion, unless the technical, organizational and cultural recommendations made in this report are implemented, little will have been accomplished to lessen the chance that another accident will follow (CAIB).

Reason and Hobbs offer similar comments about the treatment of human error.

> Errors are consequences not just causes. They are shaped by local circumstances: by the task, the tools and equipment and the workplace in general.
>
> If we are to understand the significance of these factors, we have to stand back from what went on in the error maker's head and consider the nature of the system as a whole (Reason and Hobbs).

Reason and Hobbs emphasize looking into the system as a whole to identify causal factors. As a result of the analyses made of causal factors for incidents which result in serious injury, this author suggests that incident investigation should be considered as:

- A prime source for selecting leading indicators for safety management system improvement. If incident investigation is done well, the reality of the technical, organizational, methods of operation and cultural causal factors in the work system will be revealed.
- Deserving of a much higher place within all of the elements of a safety management system. The quality of incident investigation emerges as being one of the primary markers in evaluating an organization's safety culture.

To Reduce Serious Injury Potential

In addition to the improvements in safety management systems that may become apparent from the proposed studies, SH&E practitioners should take proactive measures and consider initiating the following actions.

1) Conduct a needs assessment to determine how much creative destruction and educational reconstruction is needed to: a) counter the beliefs that focusing on reducing incident frequency will equivalently reduce severity, and unsafe acts of workers are the principal causal factors; and b) recognize the benefits to be gained as a result of an additional emphasis on serious injury prevention.

If it is believed that concentrating on incidents which occur frequently encompass severity potential and that the unsafe acts of employees are the principal causes of accidents, a major culture change will be necessary to reduce the potential for low-probability/severe-consequence incidents.

In any case, educational reconstruction may be needed to achieve a mindset that recognizes the particulars of severe injury potential and the opportunities that such recognition presents. This newly adopted mindset should affect every element in the safety management system so as to cause all involved to continuously think about identifying severe injury and illness potentials, and reducing the probability of the potentials being realized, with an emphasis on being proactive and anticipatory. That will be particularly significant in the design processes that affect facilities, equipment and work methods.

In conducting a needs assessment, it should be understood that traditional safety management systems do not include activities to anticipate and identify the causal factors for low-probability/severe-consequence accidents—nor do they include particularly crafted efforts for their prevention.

Reason notes that occupational safety approaches directed largely on the unsafe acts of persons have limited value with respect to the insidious accumulation of latent practices and conditions which are typically present when organizational accidents occur (Reason).

2) Promote the adoption of a pre-job planning and safety analysis system for unusual and nonroutine work, since a large percentage of incidents that result in serious injury occur in that type of activity. This idea is gaining momentum. For example, two large companies have recently set goals to have pre-job planning systems in place for nonroutine work in all of their operations. Pre-job planning systems help to improve both productivity and risk reduction [Manuele(e)].

3) Encourage institution of a variation of the critical incident technique to gather worker comments on the hazards and risks that present serious injury potential, especially concerning near-hit incidents which could have had serious consequences under slightly different circumstances. Adopting such a system can improve upward communications from workers if their knowledge and skills are properly

respected. Valuable information can be obtained from the application of this relatively inexpensive data-gathering method.

In a bulletin on ergonomics methods and tools titled "Task Analysis Methods: Critical Incident Technique," the authors state, "The critical incident technique is inexpensive and provides rich information. This technique is helpful in emphasizing the features that will make a system particularly vulnerable" (Infopolis).

Speaking of incident recall, Johnson observes:

> Incident recall is an information-gathering technique whereby employees (participants) describe situations they have personally witnessed involving good and bad practices and safe and unsafe conditions. Such studies, whether by interview or questionnaire, have a proven capacity to generate a greater quantity of relevant, useful reports than other monitoring techniques, so much so as to suggest that their presence is an indispensable criterion of an excellent safety program (W.G. Johnson).

A system that seeks to identify causal factors before their potentials are realized would serve well in attempting to avoid low-probability/severe-consequence events. Such a system can be installed inexpensively [NSC(a); Manuele(d); Tarrants; Welker, et al; Infopolis].

4) Assess the quality of incident investigations and arrange for improvement so that investigations address true causal factors and so that the reports can be a source for selecting leading indicators for serious injury prevention. As noted, a culture change may be needed to achieve this.

Who Benefits?

Who benefits from an extended focus on the prevention of incidents that result in serious injury? Few entities have all the resources, staffing and funds needed to address every hazard and every risk deriving from those hazards. It is simply reality that some things pertaining to safety do not get done.

Therefore, priorities should be set so that the available resources are applied to do the most good. If a safety management system includes specific provisions for the prevention of severe-consequence incidents and they are successful:

- workers benefit since they will have fewer serious injuries;
- employers benefit because the escalating workers' compensation costs and their relative indirect costs would be substantially reduced.

Conclusion

The goal of this article is to encourage SH&E practitioners to identify the characteristics of the "critical few" incidents that result in serious injury and to take action to minimize the potential for their occurrence. While the adverse trending of incidents resulting in serious injuries has negative implications, it also provides opportunities.

As noted, achieving greater effectiveness in reducing serious potential may require changes in an organization's safety culture, which is not easy to do. However, SH&E professionals are obligated to perform the analyses necessary to identify the safety management system modifications needed to achieve a more effective focus on serious injury prevention. If that is achieved, the beneficial results can be substantial. ■

Educational reconstruction may be needed to achieve a mindset that recognizes the particulars of severe injury potential and the opportunities that such recognition presents. This mindset should affect every element in the safety management system.

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