Leading Measures

Enhancing safety climate and driving safety performance

By Earl Blair and Michael O'Toole

Abstract: *One way to influence and enhance safety culture is to establish and implement safety metrics that drive safety performance. This article provides suggestions about various kinds of measures and related approaches to accomplish this goal.*

SH&E PROFESSIONALS KNOW several applications for trailing measures, such as trend analysis, control charts and evaluating the effectiveness of safety initiatives. The problem many organizations encounter is that the measures they use do not provide adequate feedback for continuous improvement of the safety process nor do they contribute to the development of the safety culture. The safety culture is unlikely to be positively affected when trailing indicators are the primary focus or are the sole safety metrics an organization uses to assess performance.

Leading indicators measure actions, behaviors and processes, the things people actually do for safety, and not simply the safety-related failures typically tracked by trailing measures. Performance has two aspects: "Performance is a function of both the behavior and accomplishment of a person or a group of people. Performance includes the actions of a person or people and the result of the action or actions" (Stolovitch & Keeps, 2004, p. 8). This distinction is important to understanding activity measures (behaviors) versus results measures (accomplishments).

A Recommended Approach

The best approach to comprehensive safety measures includes a mix of trailing indicators (accomplishments, results and outcomes) and leading indicators (behaviors, processes and activities). ANSI Z10-2005 encourages such a mix, particularly in Part 6.1, Monitoring, Measurement and Assessment, which includes the following statement in the right-hand column (the "should" or recommendations column):

> E6.1: The purpose of these processes is to help evaluate the performance of the management system by measuring its effectiveness in controlling and reducing risk. Organizations should develop predictive or "leading" performance measures or indicators. The organization can use these measures to identify and correct problems and identify opportunities for risk reduction before injuries or illnesses occur. The leading indicators can be used in combination with carefully collected injury and illness rates to measure performance. Some examples of indicators of potential problem areas are human factors risks, near-miss incidents and nonconformances found during inspections" (ANSI/AIHA, 2005, p. 18).

The standard further states:

> E6.1C: These (injury and illness) rates, however, should rarely be the sole or primary tool to evaluate performance of an OHSMS (Occupational Health and Safety Management System), for several reasons. Primarily, these rates measure the very injuries, illnesses and material losses that a management system is trying to prevent. When injury indicators are the only measure, there may be significant pressure for organizations to "manage the numbers" rather than improve or manage the process (ANSI/AIHA, 2005, p. 19).

Customize Safety Metrics by Site

Specific strategies for how to best integrate this mix of trailing, concurrent and leading indicators become a challenge when planning how to improve safety performance and the ways to develop the safety culture. First, SH&E practitioners want to know what specific metrics are indicated for their organization. Since no set of measurements is right for all (Rinefort, 1976), the safety metrics that are best for any particular site must be determined on a case-by-case basis and customized based on the current circumstances.

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Second, consideration may be given to the mix of leading indicators versus trailing indicators. For example, should it be 50/50 or favor one kind of indicator over the other? The authors recommend a mix that favors leading and concurrent indicators, such as 80% leading/20% trailing, or an even greater emphasis on leading indicators. This is based on the fact that when a company does a good job of focusing on what it is doing for safety, over time, the trailing indicators will reflect the safety accomplishments and thus lower injury rates, workers' compensation costs and other outcome measures.

A Useful Strategy: Establish Measures Designed to Improve Safety Culture

Various researchers and experts agree that culture is a primary driver and predictor of improving safety performance (Carder & Ragan, 2003; Flin, Mearns, O'Conner, et al., 2000). Manuele (2001, 2008) is emphatic that "the level of safety performance achieved is dictated by the culture of the organization." Geller (2005) notes that "safety should be driven by the local culture" and that "culture change requires that people understand the principles (of long-term culture change) and know what to do about them" (p. 5).

Manuele (2008) elaborates on the significance of organizational culture:

> Safety is culture-driven, and management establishes the culture . . . an organization's culture translates into a system of expected behavior. . . . The injury and illness experience that results is a direct reflection of an organization's safety culture. . . . Major improvements in safety will be achieved only if a change in culture takes place—only if major changes occur in the system of expected behavior" (p. 82).

Obviously, the system of expected behavior is greatly influenced by what is measured and rewarded. To provide meaningful direction, develop safety measures to continually improve the safety culture over the long-term. Well-chosen leading indicators contribute to continual improvement of the safety culture in the following ways:

- Leading indicators serve as a catalyst for change.
- Meaningful metrics are motivational for both employees and management.
- Leading indicators ultimately drive safety performance (Blair & Spurlock, 2008).

Expanding on each point, metrics do not necessarily produce change but when well-chosen, with culture development in mind, they may fuel the changes needed in organizational culture. This is especially true when established safety metrics provide strong directional focus and specific, expected safety-related responsibilities and accountabilities at all levels.

Employees at all levels can fully buy into meaningful safety metrics. Metrics that encompass direction, elucidate specific responsibilities and demonstrate a direct connection to reduced injuries tend to be highly motivational. With focus, clarity and regular measurement of accountability, employees are likely to apply their efforts to the process of improving the safety culture through the application of the established metrics.

So Which Metrics Drive Safety Performance?

For individual accountability, well-chosen leading measures will drive specific behaviors and activities. This is especially true if, when those metrics are implemented, individuals are evaluated and rewarded based on those objectives/metrics. To ensure that process metrics are robust:

- include them in employees', managers' and supervisors' evaluations;
- ensure that the operating line implements the metrics and follows up as appropriate.

SH&E professionals can add value to their companies by identifying the specific metrics that enhance site safety culture. Determining the best metrics and the best mix for a specific site or organization is both an art and a science. Manuele (2008) notes that when measuring risk assessment systems "the fact is, risk assessment process is as much art as science" (p. 165).

SH&E professionals can use powerful tools such as Manuele's risk score formula, but must keep in mind that the numerical scoring system is derived from subjective assessments of the risk levels. It is not straight science; it involves art and an element of subjectivity as well. As Manuele notes more than once, "Numerical risk scores carry an image of precision that can influence decision making and priority setting. In reality . . . they should not be the sole or absolute determinant" (p. 182).

Priorities for selecting measures are based on existing hazards, risk levels and site history, including an in-depth analysis of injuries and near-misses. The areas of the safety culture that might be measured include those actions that employees at all levels consistently take to reduce or eliminate latent and active hazards. Consider tracking specific management activities on an ongoing basis to support the development of a positive safety culture.

Well-Chosen Soft Metrics = Big Impact

Elements of the safety process that have typically been considered subjective or soft can offer the greatest return on improving safety performance. The challenge is to choose specific aspects that most positively influence the culture, then add numeric ratings to make measurements meaningful.

Stewart (2002) exemplifies the potential impact of soft measures. "Management commitment, line ownership and workforce involvement are the fundamental drivers of safety. These 'soft' factors are supported by comprehensive safety systems and practices . . . in organizations with excellent safety; these systems and practices are meticulously implemented and continuously improved." The challenge is to develop and use meaningful measures based on these key factors.

Echoing Stewart's comment, the basic elements of OSHA's Safety and Health Program Management Guidelines remain as relevant today as when they were first published in 1989. For customizing safety

metrics, consider these guidelines and develop detailed metrics that support their accomplishment:

1) management's commitment level to safety, as perceived by employees;

2) employee involvement in specific safety efforts related to their job function;

3) worksite analysis focusing on prioritizing and reducing or eliminating the most severe hazards and exposures;

4) hazard prevention and control using the concept of the working interface (Krause, 2005);

5) safety and health training including quality level of training and transfer of learning to the workplace.

ANSI Z10-2005 suggests examples of leading indicators an organization can use in its metrics mix:

> Examples of indicators that demonstrate the effectiveness of the OHSMS are the reduction of average exposure levels, the rate and timeliness of completion of corrective actions, the completion of required maintenance or the completion of required training, and tests of their effectiveness. Indicators should be designed according to the hazards in the workplace (p. 18).

Safety Audits as Effective Drivers of Safety Performance

The authors are familiar with several large organizations, including multinationals, that use elaborate auditing processes to verify and measure improvements in their comprehensive OHSMS. Although none of these organizations has published its internal safety and health results, all report anecdotally that the audit results correlate strongly with reductions in injury rates. Several of these organizations report that one benefit of the audit process is the opportunity to take corrective actions based on the findings. These actions allow the management team to support the safety process as well as its continuous improvement.

Manuele (2008) suggests that the principle purpose of the safety audit is to improve the safety culture. Kase and Weise (1990) state, "Success of a safety auditing program can only be measured in terms of the change it effects on the overall culture of the operation" (as quoted in Manuele, 2008, p. 362). For safety audits to be genuinely useful, they should be designed for the purpose of improving safety management systems and the resulting culture. Additionally, effective audits must include meticulous follow-up to address any weaknesses revealed.

Developing Measures: Prioritize Risks

A good tool for measuring risk level and, consequently, establishing measurement priorities, is Manuele's risk score formula, a three-dimensional risk matrix (sidebar above). Measuring safety performance is about developing the safety management system and the related safety culture. ANSI Z10-2005 is currently state of the art for safety management systems, and Manuele's (2008) book is an excellent resource for additional details on risk formula scoring and ways to reduce serious injuries.

Examples of Leading & Concurrent Measures From Industry

Qualitative Metrics for System & Employee Behaviors

The oil drilling industry provides a case study on using leading measures in construction (Toellner, 2001). During a highly hazardous project, both safe system behaviors and employee behaviors were emphasized. Five specific measures were evaluated

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Developing Measures: Prioritize Your Risks

A good tool for measuring your risk level, and consequently establishing measurement priorities, is Manuele's Risk Score Formula, a three-dimensional risk matrix. With permission from the author, his formula from *Advanced Safety Management* is presented here:

RS = (PR + FER) x SR

Where:

RS = risk score
PR = probability rating
FER = frequency of exposure rating
SR = severity rating

Risk score = (probability rating + frequency of exposure rating) x severity rating

Descriptive Words & Ratings

Probability

Frequent (15): Likely to occur repeatedly
Likely (9): Likely to occur several times
Occasional (4): Occurs sporadically
Remote (1): Not likely to occur, but possible
Improbable (0.5): So unlikely can assume occurrence will not be experienced

Frequency of Exposure

Often (13): Continues to occur daily
Occasional (10): Daily to monthly
Infrequent (7): Monthly to yearly
Seldom (4): Less than yearly

Severity

Catastrophic (50): Fatality, exceeds $2 million
Critical (40): Disabling injury or illness, $500,000 to $2 million
Medium (25): Minor injury or illness, $50,000 to $500,000
Minimal (10): No injury or illness, less than $50,000

Risk	*Score*	*Action or Acceptance*
High	800+	Operation not permissible
Serious	500-799	High priority remedial action
Moderate	200-499	Remedial actions taken at appropriate time
Low	< 200	Risk is acceptable, remedial action discretionary

Application Examples

Probability	*FRE*	*Severity*	*Risk Score*
1) Frequent (15)	Often (13)	Critical (40)	(15 + 13) x 40 = 1,120
2) Likely (9)	Occasionally (10)	Catastrophic (40)	(9 + 10) x 50 = 950
3) Remote (1)	Seldom (4)	Minimal (10)	(1 + 4) x 10 = 50

Note. *Adapted from* Advanced Safety Management: Focusing on Z10 and Serious Injury Prevention, *by F.A. Manuele, 2008, New York: John Wiley & Sons.*

and scored for quality and quantity: 1) safety meetings; 2) housekeeping; 3) barricade performance; 4) job safety analysis; and 5) safety walks.

These proactive metrics included qualitative assessments, not just quantitative tallies of the number of times per month and so on.

For example, safety meetings were not simply tallied; they were evaluated for qualitative elements such as starting on time, facilitator competence (someone had to observe) and employee participation. Likewise, safety walkthroughs were not simply tallied; instead, they became a way for supervisors to talk with workers about specific safety issues and to follow up on the performance level of other safety metrics such as housekeeping, job safety analyses and barricade performance.

The safety walks were initially viewed by some as the "traffic cop" coming through, but employees eventually accepted and embraced them. These walks became a way for management to emphasize safety and demonstrate that it cared about employees. In a real sense, walkthroughs became a way to actively care (Geller, 2005) for safety. The result of applying these measures were 2 million hours of work performed with only one recordable injury.

Emphasizing Employee Engagement

The efforts of a large U.S.-based brewery provide an example from manufacturing. This site developed a safety management process (SMP) that involved an aggregate score of 100 possible points. The process metrics were designed to measure all aspects of the site's safety management system.

The SMP is a proactive process that is skewed 85% toward a focus on leading indicators and 15% on trailing indicators. As the site involved a team approach to the work, this was incorporated as part of SMP. The 100 points breakdown as 60 points for individual safety participation, 20 points for team safety participation, 5 points for compliance training (for a total of 85 points related to leading metrics) and 15 points for case incident rates.

The company implemented several innovative methods to help ensure success. First, since the site used scorecards, employees were also "scorecarded" for safety performance. Second, while employees were given a quota for the number of safety activities in which they were expected to participate, they were also given a choice about which safety activities they would participate in. Those involved considered employee choice to be a key factor to the program's success.

The types of activities used to measure individual safety participation included:

- observation cards;
- job safety analysis (JSA) (including training and auditing);
- safety meetings and safety audits;
- maintenance walkthroughs;
- preshift stretching;
- industrial hygiene sampling requests/results;
- ergonomic assessments.

Although compliance training was given 5 points or 5% of the total SMP measure, the site team designed it in such a way that compliance training went from approximately 39% of the 2,000 employees participating to more than 99% participating after SMP implementation. Consequently, the brewery became one of the top safety performing breweries in the U.S., working more than 1 million hours without a lost-time injury multiple times. The SMP has been so successful it has spread throughout the organization.

Concurrent Measures From Industry

Risk Mapping for Loss Patterns

Concurrent measures are process-based measures of performance. Traditional measures may be inappropriate for monitoring and diagnosing deficiencies at the operational or process level. The construction products industry provides the following example.

One firm implemented a risk-based intervention that involved a risk mapping process. In this case, the company analyzed 3 years of incident data and identified several common factors associated with injuries to local concrete delivery truck drivers. The two most prevalent factors used to predict future outcomes were a failure to use three points of contact when mounting or dismounting the truck, and injuries resulting from the handling of chutes before and after pouring concrete.

The risk mapping process revealed patterns of historical loss as well as potential seasonality of loss since this organization's business volume increased in March, peaked during the summer and tailed off in November. The company identified at-risk jobs or tasks based on injury and incident occurrences over time. The process was blended with a simplified risk assessment where the most significant hazards with the greatest exposure to employees are ranked in order to help focus corrective actions given limited resources.

Once the two prevalent factors were identified, the mean time between incidents (MTBI) was calculated for each factor noted. This metric revealed that one loss incident involving three points of contact occurred every 22 days on average. Injuries resulting from chute handling exposures occurred an average of one incident every 33 days.

Several actions followed. First, management met with employees and managers to share the findings of the risk mapping process. Second, managers were asked to focus their behavioral observation and feedback sessions with employees on these two prevalent factors. Third, lighter weight chutes (approximately 15 lb less) were introduced systematically into the fleet.

After 6 months, the MTBI for incidents related to three points of contact went from an average of one incident every 22 days to an average of one incident every 45 days. In 9 months, it was an average of one incident every 78 days. One year later, the MTBI was nearly one incident every 120 days.

For chute handling losses, after 6 months, the MTBI went from an average of one incident every 33 days to an average of one incident every 51 days. After 9 months, the MTBI was one incident every 86

days and after 1 year, it was one incident every 155 days. The resulting reduction in workers' compensation costs associated with the chute handling incidents (which often caused ligament damage requiring corrective surgery) more than offset the costs of the lighter replacement chutes.

Employee Perception Surveys as Measurement Tools

More organizations are recognizing the importance of a positive safety culture in achieving and maintaining exceptional safety results. Research has demonstrated that an organization's safety culture is a major influence shaping the safety- and health-related behaviors of employees (Seo, Torabi, Blair, et al., 2004).

The term *safety climate* is often used to describe the tangible outputs or indicators of an organization's safety culture, as perceived by individuals or work groups at a given point in time. Examples include:

- how employees view the importance the organization gives to safety relative to quality, production or customer service;
- how committed the employees believe their superiors or peers are to safety.

Various commercial questionnaires are available. They consist of a series of statements about which participants indicate a relative degree of agreement. They are designed to record employees' perceptions of key aspects of SH&E management within the organization and on some key issues that are recognized as important to successful injury prevention.

Managers, supervisors and workers are asked to express the extent to which they agree or disagree with these statements on a Likert (or similar) scale. Such a questionnaire seeks the perceptions of employees in these three discrete groups so that their results can be compared in order to detect differences between them. Organizations with relatively high agreement between the groups tend to have lower injury rates than organizations in which agreement is lower (O'Toole, 2002). Previous research suggests that employees' positive perception of management's commitment to safety can result in reduced incidents that lead to injury (Bailey, 1988; Clarke, 1999).

Generally, these surveys provide a snapshot of an organization's culture and can be a useful tool in developing measures to drive safety culture. Well-designed and customized safety perception surveys provide the following benefits to an organization:

- **Practical.** Address the primary safety issues. Even if just perception, the perceptions are real to those who hold them and must be addressed.
- **Predictive.** They fulfill the definition of what a leading indicator is supposed to do.
- **Prescriptive.** The results generally indicate clearly what needs to be addressed.
- **Proactive.** Preferable to accident investigation which is a reactive measure (Blair & Spurlock, 2008).

Employee and managerial perceptions are critical to the success of a safety and health process. If the perceptions held by managers are not positive, those perceptions translate into behaviors that influence the perceptions of their subordinates. Hourly and production workers' perceptions about their organization's safety and health processes affect their tendency to act in a safe manner (follow prescribed safety procedures, for example) or at-risk manner.

Research suggests that safety culture establishes norms of behavior with cohesive work groups that influence injury rates (McDonald, Corrigan, Daley, et al., 2000). Perception surveys attempt to measure various factors considered to be indications of the safety and health culture. A more recent study (O'Toole, 2002) suggests that employees' perceptions of management and the company's commitment to safety and health directly affect the reduction of injuries over time.

Safety climate perception surveys can 1) identify safety trends; 2) enable an organization to focus on the most problematic areas; 3) serve as a leading indicator of safety performance; and 4) establish a baseline for future measurements. A climate scale developed at Indiana University includes these five dimensions: 1) supervisor safety support; 2) coworker safety support; 3) management commitment to safety; 4) employee participation in safety-related decision making and activities; and 5) employees' safety competence level (Seo, et al., 2004).

When organizations address weaknesses discovered by measuring these dimensions through perception surveys, the information is available to develop countermeasures that influence the safety culture and enhance safety performance.

Research suggests that employees' perceptions of management and the company's commitment to safety and health directly affect the reduction of injuries over time.

Conclusion

The following suggestions are offered to those seeking to develop effective safety measures:

- **Customize by site.** No measures will work effectively for all industries or even all locations within the same organization. Sites must use more than one safety metric to create a more robust picture of their safety results and culture.
- **Prioritize by severity, based on risk assessment.** Since all organizations have limited resources (time, money, personnel), the focus must be on the hazards with the highest risks. Conducting risk assessments across the organization, within a facility, by department or shift, or for a specific job function or task will likely yield the greatest benefits.
- **Simplify by limiting the total number of safety metrics.** The adage "what gets measured and rewarded, gets done" is familiar to all. However, if too many things are measured, nothing tends to get done. Lagging indicators will likely continue to be used. Despite the statistical issues related to traditional safety metrics, these data can provide valuable information, especially when used in combination with well-selected current and/or leading indicators.
- **Engage employees in development of safety measures and related goals.** Like any other aspect of the SH&E process, employee engagement is essential. Enlisting employees to help develop safety metrics will increase their understanding of them and

Six Guidelines for Effective Safety Measures

1. Customize measures specifically for individual sites.
2. Use risk assessment to prioritize safety measures by severity.
3. Simplify by limiting the total number of safety measures used at any time.
4. Engage employees meaningfully in the development of safety measures and related safety goals.
5. Use a thoughtfully chosen mix of performance and outcome measures.
6. Design your measures to specifically influence the safety culture.

their value to the organization's efforts to reduce loss-producing incidents.

•Use a thoughtfully chosen mix of performance and outcome measures. The first responsibility and function of management is planning. During the planning phase, carefully consider what to measure and why. Also consider how the data generated by the safety metric(s) selected will be used to help the organization continuously improve safety results.

•Design measures to specifically improve the safety culture. The *why* of measurement makes a statement about the organization's safety culture. The selection of specific performance and outcome measurements tells the entire workforce whether the organization values safety. If measurements selected are counter to the existing safety culture, confusion will occur and begin to adversely affect the safety culture. This clearly connects to the planning aspect of identifying which factors to include within the metrics mix.

Leadership exerts the primary influence on an organization's culture and the derivative safety culture. However, this culture can be influenced in other ways as well. Thoughtfully developed safety metrics, with the support and inclusion of leadership in their development and as a level included in the measurement, can also have a powerful impact on the journey to a strong safety culture. ■

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