

Leading Measures Preventing MSDs & Driving Ergonomic Improvements

By Walt Rostykus and James Mallon

Improving ergonomics to prevent musculoskeletal disorders (MSDs) is a key element of OSH programs for most organizations. MSDs are a major cause of losses and a persistent source of frustration. The authors have heard from OSH managers about the challenges in proving to their top managers the effectiveness and value of their current ergonomics program. Through benchmarking studies and experience working with Fortune 1000 companies, the authors have determined that the success or failure of an organization's ergonomics program depends on the selection of a few correct measures. Unfortunately, traditional lagging safety measures, specifically injury/illness rates, are still used by many safety managers to drive struggling ergonomics programs (Aon, 2016; Humantech, 2011). The OSH profession has identified reliance on lagging measures as a root cause for failed and ineffective ergonomic improvement programs.

This article details the few leading measures specific to MSDs that are proven to ensure leadership support and resources, and to sustain the ergonomic improvement program across multiple locations and across time. It also provides definitions and illustrations of different types of measures to enable OSH managers to better evaluate and select the optimal measures for their organizations.

Traditional Safety Measures Applied to MSD Management

To understand the best measures for managing MSDs, one must understand the foundation of the most commonly used safety measure, the injury/illness rate. Use of this lagging measure began in 1972, with reporting injuries and illnesses to Bureau of Labor Statistics (BLS) through the Survey of Occupational Injuries and Illnesses (SOII), and it became the basis for the OSHA recordkeeping requirements in 1978 (OSHA, 2009).

Reported through the OSHA log, the injury/illness rate provided a common measure for all employers to use when comparing their performance (injury rate) with their industry type (BLS, 2016a). BLS (2016b) describes the purpose of SOII estimates as a method to provide national and state policymakers with:

An indicator of the magnitude of and trends in occupational safety and health problems. OSHA uses the statistics to help measure the effectiveness of its enforcement and outreach programs in reducing work-related injuries and ill-

IN BRIEF

- Traditional safety metrics of injury rate and losses are poor measures of workplace ergonomics or predictors of musculoskeletal disorders (MSDs).
- Current research and valid assessment tools allow reliable measurement of exposure to the risk factors that cause MSDs. Coupled with the threshold limit of joints in the body, this allows reliable prediction of tasks with increased potential for developing an MSD.
- Leading risk-based measures for MSDs enable sampling, predicting, preventive actions, and verification of risk exposure. This approach fits well within the structure of a comprehensive safety management system.

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nesses. Both labor and management use SOII estimates in evaluating safety programs. Other users include insurance carriers involved in workers' compensation, industrial hygienists, manufacturers of safety equipment, researchers and others concerned with job safety and health.

In simple terms, it provided a common measure that was easily recorded, tracked and reported by both employers and their insurance carriers, from which to evaluate safety and health program effectiveness.

Unfortunately, several issues have been identified with its use. BLS identified one of the many issues with gaining valid and useful indicators from the SOII:

Many factors can influence counts and rates of injuries and illnesses in a given year. These include not only the year's injury and illness experiences but also employers' understanding of which cases are work-related under current OSHA recordkeeping guidelines. The number of injuries and illnesses reported in a given year also can be affected by changes in the level of economic activity, working conditions and work practices, worker experience and training, and the number of hours worked. (BLS, 2016b)

Other issues with the SOII/OSHA log include the quality and validity of information recorded and the effort required to record the information. In testimony to the U.S. House of Representatives, Committee on Education and Labor, Robert McLellan, past president of American College of Occupational and Environmental Medicine said, "At its best, [maintaining OSHA logs] results in intensive efforts to improve safety. At worst, however, the spotlight on the log produces efforts to make the log look good rather than placing attention on reducing risks" (Walter, 2008). Introducing the need for a leading indicator of safety, McLellan continued:

The OSHA log itself will not give a true look for the purpose for which we really have it, which is to prevent work-related injuries and illnesses. The OSHA log even at its best is only going to be a lagging indicator, and it is a body count. We would really like to be able to use a suite of indicators that take a look at the bottom of the iceberg in order to prevent anyone from getting

on the OSHA log for the real reason because it is safe. (Committee on Education and Labor, 2008)

Although the injury/illness rate provides employers with a way to compare their safety performance with their industry type, it is not an ideal measure for driving safety performance. Unfortunately, too many business leaders have adopted this measure and trust it as a true reflection of the safety of their operations.

The reliance on a nonspecific, lagging measure was illustrated by Don Blankenship, Massey Energy CEO, following the 2010 explosion that killed 29 miners in West Virginia. During an interview, the interviewer commented that the company "has not done enough to keep the mines as safe as they ought to be." Blankenship responded:

We typically have a safe or better performance than the rest of the industry; 18 of the last 20 years we've had a better safety performance than the rest of the industry. . . . We've cut the accident rate at Massey probably about 90% over the time that I've been president and our goal is zero. This year we were doing really well until this and we're sorry about it and as distressed about it as others are. (CBS, 2010)

This statement illustrates the need for all aspects of safety to be managed by specific and leading measures that enable organizations to anticipate exposures and prevent injuries, illnesses and fatalities. Tragic workplace incidents could be predicted and avoided by using metrics that focus on causes, not consequences.

So how does the injury/illness rate tie to MSD management? Many organizations continue to use it, or the incidence of MSD injuries, as their primary measure for workplace ergonomics. In Humantech's (2011) most recent benchmarking study on management of ergonomics, 80% of participants continued to rely on MSD incidence rate as their primary measure. It is the authors' experience that ergonomics and MSD prevention are best managed using a mix of different types of measures: leading, results-based, and operations- or systems-based indicators.

Leading vs. Lagging Measures

So far we have referred to two types of measures: leading and lagging. They are well defined in the literature by many authors (Campbell Institute, 2015; Petersen, 2005; Stough, 2012; Toellner, 2001). These authors define leading measures as indicators that proactively identify potential issues (e.g., injuries, illnesses) before the event happens, which enables an employer to take action to prevent the occurrence (Figure 1). This is what McLellan's testimony was advocating. In contrast, lagging measures are trailing measurements of the outcome of an event or incident.

The bottom line is that leading indicators provide advanced warning of potential events or incidents and, when timely, allow an employer to take action to prevent an injury, illness or, in the case of poor ergonomics, an MSD (Campbell Institute, 2015; Humantech, 2011).

FIGURE 1

Leading vs. Lagging Measures

Leading (proactive)

Causes

- Ergonomic risk
- Cycle time

Event

Lagging (reactive)

Consequences

- Injury/illness rate
- Work-related MSD rate
- Lost work days
- Workers' compensation rate
- Workers' compensation cost
- Cost per injury

The use of leading measures for managing safety is increasing in practice (AIHA, 2001; Campbell Institute, 2015; Humantech, 2011). Campbell Institute (2013a) notes:

The mix of key indicators in EHS performance evaluation varies from company to company, and world-class organizations are keen to recognize that basing compensation solely on lagging indicators is not the pathway to EHS excellence. It is evident, regarding the issue of EHS and performance evaluation, that world-class organizations have been incorporating more leading metrics into their overall assessments, a trend that will continue and no doubt be emulated by up-and-coming organizations.

In the authors' experience, using leading measures based on MSD risk exposure is the most effective and efficient way to drive ergonomic improvements in the workplace. Humantech's 2011 benchmarking study indicates that 46% of participants had adopted or planned to adopt leading measures for ergonomics.

Activity & Results Measures

Measures can also be categorized by what they are measuring: activities or results (AIHA, 2001). Activity measures are indicators of actions taken or tasks completed (e.g., training completed, assessments conducted, improvements made). These measures are useful when starting an ergonomic improvement process to provide momentum and drive until the process is well established and maintained. They assist a site and the team supporting the site ergonomic improvement process in monitoring progress toward plans and goals. The results of these activities feed into the measurement of risk level and risk reduction (results measures).

Measures of results are those indicating progress or changes in conditions. For ergonomic processes, these are the measures of reduction of MSD risk exposure at an individual workstation, at all workstations within a department, across a single plant, or across a business unit or enterprise. They are a measure of both how well people (engineers, managers, leaders, ergonomics teams) perform activities and the results of those activities.

Operations-Based & Systems-Based Measures

Another category of measures for safety and ergonomics indicates the relevant scope of the program. This includes operations-based and systems-based measures (Campbell Institute, 2015; Dalto, 2016).

TABLE 1

Recommended Systems-Based Measures for MSD Reduction

Key performance indicators	Type	Tracking method	Frequency
% of workstations/jobs at low/no risk	Leading results	Ergonomics process software	Monthly
% reduction of MSD risk	Leading results	Ergonomics process software	Monthly

TABLE 2

Recommended Operations-Based Measures for MSD Reduction

Implementation measures	Type	Tracking method	Frequency
% of planned workplace improvements implemented	Leading activity	Ergonomics process software, site improvement plans	Monthly
% of targeted workstations/jobs assessed for risk	Leading activity	Ergonomics process software, site improvement plans	Monthly
% new workstations/tools/equipment at low/no risk upon purchase or installation	Leading activity	Engineering design review process	Monthly
% of targeted employees completing appropriate level(s) of training	Leading activity	Ergonomics process software, learning management system	Monthly

Operations-based measures are indicators of the functioning of an organization's (site's) safety or ergonomics program. For ergonomics, these are typically measures of the activities performed to make workplace changes to reduce MSDs. Examples include training engineers and teams, conducting MSD risk assessments and implementing risk reduction improvements. These measures drive and make routine the actions of those supporting the site process. In the authors' experience, these measures should be tracked for 2 to 3 years to establish familiarity of their use and realization of their outcome until the ergonomic improvement process is sustained.

Systems-based measures are higher-level key performance indicators (Parmenter, 2007; Stough, 2012) that business leaders should track and monitor. This applies to both the leaders at a site (e.g., plant manager) and enterprise-wide (division-wide, company-wide). They are used to track and evaluate an organization's success, in this case to achieve the common goal of its ergonomics process. These results measures indicate how well the ergonomic improvement process or management system is being managed. Instead of MSD incidence rate, the authors recommend two systems measures to drive risk reduction and ensure accountability within the organization (Tables 1 and 2).

Quantifying MSD Risk

Since the purpose of most ergonomic improvement processes is to prevent the development of MSDs, the focus must be to proactively identify and reduce employee exposure to the risk factors that cause MSDs. Fortunately, research (Bernard, 1997) shows that the three primary risk factors that cause

MSDs are high force, awkward posture, and long duration or high frequency. Increasing the combination or number of these risk factors increases the chance of employees developing discomfort, pain or an MSD. Secondary risk factors that contribute to developing an MSD include soft-tissue compression, low temperature, vibration, impact stress and glove issues.

Through ongoing research, the threshold of exposure to each of these risk factors has been quantified for each joint of the body (Bernard, 1997). As a result, valid quantitative MSD risk assessment tools are now available based on the dose-response relationship of these injuries (Marras, Allread, Burr, et al., 2000; Marras, Fine, Ferguson, et al., 1999; Törnström, Amprazis, Christmansson, et al., 2008).

An example is the risk priority score (Figure 2), which combines weighted values of exposure to MSD risk factors on nine different joints of the body, presence of secondary risk factors (e.g., tis-

sue compression, vibration, low temperature) and the total exposure time. The resulting value reflects the cumulative exposure to MSD risk factors, which can be used to prioritize and select tasks to be addressed (see the following section, "Effective Measures for Preventing MSDs"), and to balance exposures from multiple tasks when scheduling work performed during a shift.

This understanding of thresholds, compiled by NIOSH and other organizations, provides a way to measure exposure to MSD risk factors and determine where exposures exceed an acceptable threshold, and it enables OSH managers to take proactive steps to reduce exposure before an MSD injury occurs.

An additional critical measure is required when addressing MSD risk at an individual workstation: a follow-up assessment to determine the effectiveness of workplace changes and controls. This follow-up uses the same quantitative risk assessment method that was used in the initial evaluation so that the OSH professional can compare the before and after risk scores to verify that the exposure to MSD risk was reduced to an acceptable level (Figure 3).

These steps—assessing the exposure, implementing controls and verifying effectiveness—follow the same industrial hygiene or hazard analysis process used to control hearing loss, pinch points, chemical exposure and other occupational exposures (NIOSH, 1973; Rostykus, 2008).

In addition to allowing us to quickly identify MSD risks, quantifying exposure allows us to immediately measure the change in exposure following a change in the workstation (engineering or administrative controls). Not only is this metric an early warning system, but it can also provide immediate feedback on the effectiveness of controls. Measuring the level of MSD risk enables tracking, combining and reporting the results as both systems-based and operations-based measures.

Effective Measures for Preventing MSDs

So, how does all of this information lead to key measures for driving MSD prevention through ergonomic design? The solution is to focus on measuring and tracking the reduction of exposure to

FIGURE 2
Example of Whole-Body MSD Risk Assessment Results

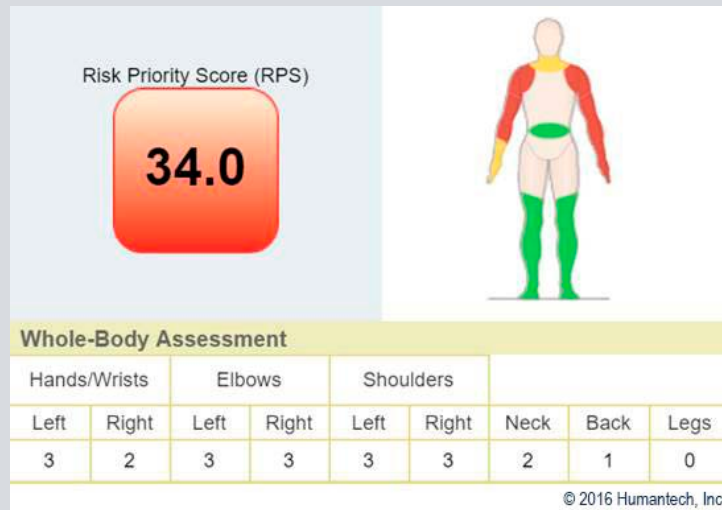
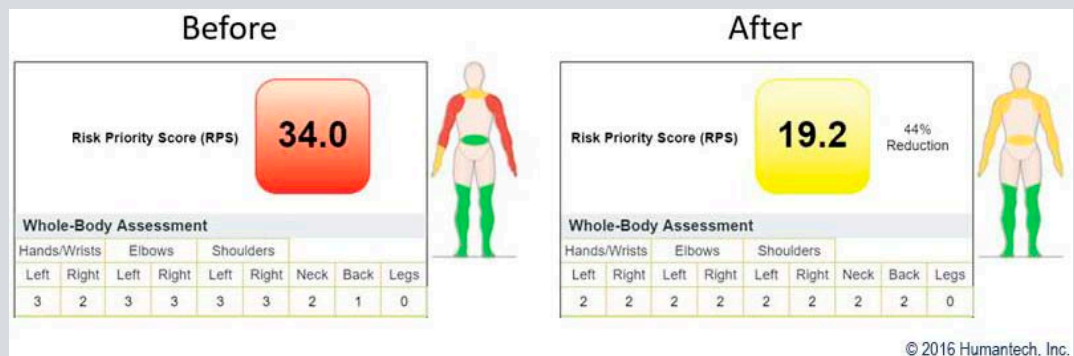


FIGURE 3
Example of Verification of MSD Risk Reduction



MSD risk factors both at individual workstations and across an organization. This approach is consistent with the current practices of systematically managing risk through a continuous improvement process, such as a safety management system (AIHA, 2001; ANSI/ASSE, 2017; ISO, 2015; Tolbert, 2005). This means relying primarily on leading (predictive) measures. But OSH professionals should consider other characteristics.

Ideal characteristics of leading measures for MSD/ergonomics management include the following:

- Accurate.** Precisely reflect the level and types of exposure in the workplace, and can distinguish exposures within one task and between tasks. This requires that valid MSD risk assessment tools are used, and used correctly.

- Understandable.** The metrics and what they measure are clearly understood.

- Meaningful.** Easy to interpret by all in the organization, aligned to their contribution and responsibility to improving ergonomics, and tied to their performance evaluations.

- Scalable.** Measures must be analyzed to determine performance across different parts of the organization, including by individual workstations; by production line or supervisory area, department, plant or business unit; and across the enterprise.

- Actionable.** Provide information that enables and drives people to take action to reduce MSD risk.

- Easy to collect, collate and report.** If collecting data on the ergonomics process is difficult and cumbersome, an organization cannot obtain complete or timely measures. A comprehensive ergonomic improvement process will generate numerous data and records; easy administration of this information is critical for success. Software tools are available to integrate assessment and design tools with project tracking and process measurement functions.

- Easy to communicate.** Present results in a manner that provides quick interpretation and understanding of the data and summaries. Color-coding results using red, yellow and green is a proven, effective method (Tjan, 2013).

- Real time.** Represent the most current conditions so that activities build from what has been done. Having current information and measures on the ergonomics process available to all individuals involved, when needed, ensures that everyone is constantly driving the job improvement process.

The bottom line: The authors recommend using measures that are leading, based on MSD risk, and results-oriented to drive the ergonomic improvement process. We recommend the following systems-based and operations-based measures.

Systems-based measures are the few key performance indicators used to drive performance across a site, business unit or company. Top management should regularly track, review and discuss these results measures as part of their dashboard of business metrics to ensure that job improvement (and MSD risk reduction) activities are driven through the organization. The authors recommend tracking two key performance indicators shown in Table 1 (p. 39).

Operations-based measures monitor, at a more detailed level, the day-to-day activities that feed into the risk reduction (systems-based) measures. The results are typically tracked by an ergonomics process manager to ensure the progress and process of a site ergonomic improvement process. These are primarily measures of activity that help engineers and ergonomics team members track the tactical steps they perform in the improvement process and meet plans. The authors recommend tracking the four key performance indicators shown in Table 2 (p. 39).

Communicating Progress to Top Managers

Many OSH practitioners struggle to effectively communicate with top management teams. High-level business leaders generally have two commonalities: Their daily agenda is full, and their priorities are continually shifting as internal and external conditions change.

Continually changing conditions mean business leaders must be able to shift focus from one issue to the next, and to prioritize them according to the issue's importance, the risk it poses to the business and its likelihood. For this reason, simply providing data points is not enough; to be effective, professionals must communicate trends and interpret the data for the leadership team.

Effective communication to leadership groups means providing an information-rich report in the fewest number of words possible. If you follow the suggestions in this article and your top management team has agreed to the key performance indicators and operations-based measures (Tables 1 and 2, p. 39), the report needs only a few more items to make it information-rich:

- direction of performance (improving, same, degrading);
- number of months in which performance was headed in the same direction;
- acceleration of direction (faster, same, slower).

At first glance, this information may not seem rich, but it is. With this information, an experienced manager knows the performance trend and the criticality of the issue. For reference, consider the Purchasing Managers' Index published monthly by Institute for Supply Management. This index is widely used as an indicator of the health of the business climate; the way data are presented is an excellent example of an information-rich assortment of economic indicators.

Conclusion

The purpose of most ergonomics programs/processes is to prevent MSDs. The solution is to ensure that the fit of the workplace and job demands are within the capabilities of the people doing the work (ergonomics). Successful organizations manage these ergonomic improvements as an ongoing, continuous improvement process (Humantech, 2011). These processes focus on identifying and reducing the causes of MSDs (exposure to MSD risk factors), rather than reacting after an MSD injury occurs. To be proactive, OSH professionals must

track a few measures based on the level of exposure to MSD risk factors. This practice is consistent with the principles of the safety management systems employed today (ANSI/ASSE, 2017; ISO, 2015), but is focused specifically on the causes of MSD injuries.

By tracking the two recommended key performance indicators as systems-based measures, OSH managers will be able to establish a common goal (reduction of MSD risks) that aligns all levels of the organization; measure the progress to that goal; measure improvement by workstation, line, department, business unit and enterprise; and hold individual engineers and managers accountable for their actions to reduce MSD risk, all using objective, evidence-based measures.

Focusing on reducing MSD risk-based key indicators will reduce the known causes of these injuries and achieve the ultimate goal: to reduce the injury/illness rate.

The authors recognize that managing MSD risk is a multifactorial situation that can seem complex. However, a keen focus on measuring and tracking the reduction of exposure to MSD risk factors at individual workstations and across an organization simplifies the challenge to manageable proportions. **PS**

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