LEADING ERGONO
Their Importance in the A

By Fred Straub

CAN THE USE OF LEADING OSH INDICATORS reduce the lagging results? The short answer is yes. Leading indicators have been a well-documented component of global occupational health and safety management systems (OHSMS) to evaluate their OSH performance. Effectively operating OHSMS reduce risk and prevent loss events that result in lagging indicators.

While leading indicators have been researched in this realm and the field of quality control, leading ergonomic safety performance indicators (SPIs) have not been specifically studied for evaluating the effectiveness of ergonomic management control programs (EMCP). The author recently completed OSH research to assess the degree to which leading ergonomic SPIs are valued and utilized, identify the perceived difficulties in implementing leading ergonomic SPIs, and examine the impact the person assigned OSH responsibilities has on the use and importance placed on leading ergonomic SPIs.

This research sought a reduction in ergonomic risk and related loss events due to the increased use of leading ergonomic SPIs to measure EMCP effectiveness. An SPI is a lagging or leading indicator to measure performance and evaluate whether a certain OSH or OHSMS goal has been achieved. This research is believed to be the first to study the perceived importance of leading ergonomic SPIs in the evaluation of EMCPs and therefore functions as a baseline for the perception and use of these SPIs, and the possible obstacles to implementation faced by today's OSH professionals.

Current OSH research and literature demonstrate reduced risk to workers and lower injury and illness rates via the implementation of operative OHSMS (Bird, Germain & Clark, 2003; Manuele, 2014a; Schultz, 2012; UL, 2013). The literature has established the success of utilizing leading indicators to evaluate the effectiveness of OSH efforts (Blair & O'Toole, 2010; Janicak, 2015; Manuele, 2009; 2013; Schultz, 2012; Telogis, 2015; UL, 2013). The author posits leading SPIs are effective in achieving required evaluations of EMCPs and OHSMS. Today, five top-favored OHSMS models promote the use of leading indicators to evaluate and predict OSH performance (ANSI/ASSP, 2017; BSI, 2007; ILO, 2001; ISO, 2018; OSHA, 2016). In addition, judi-

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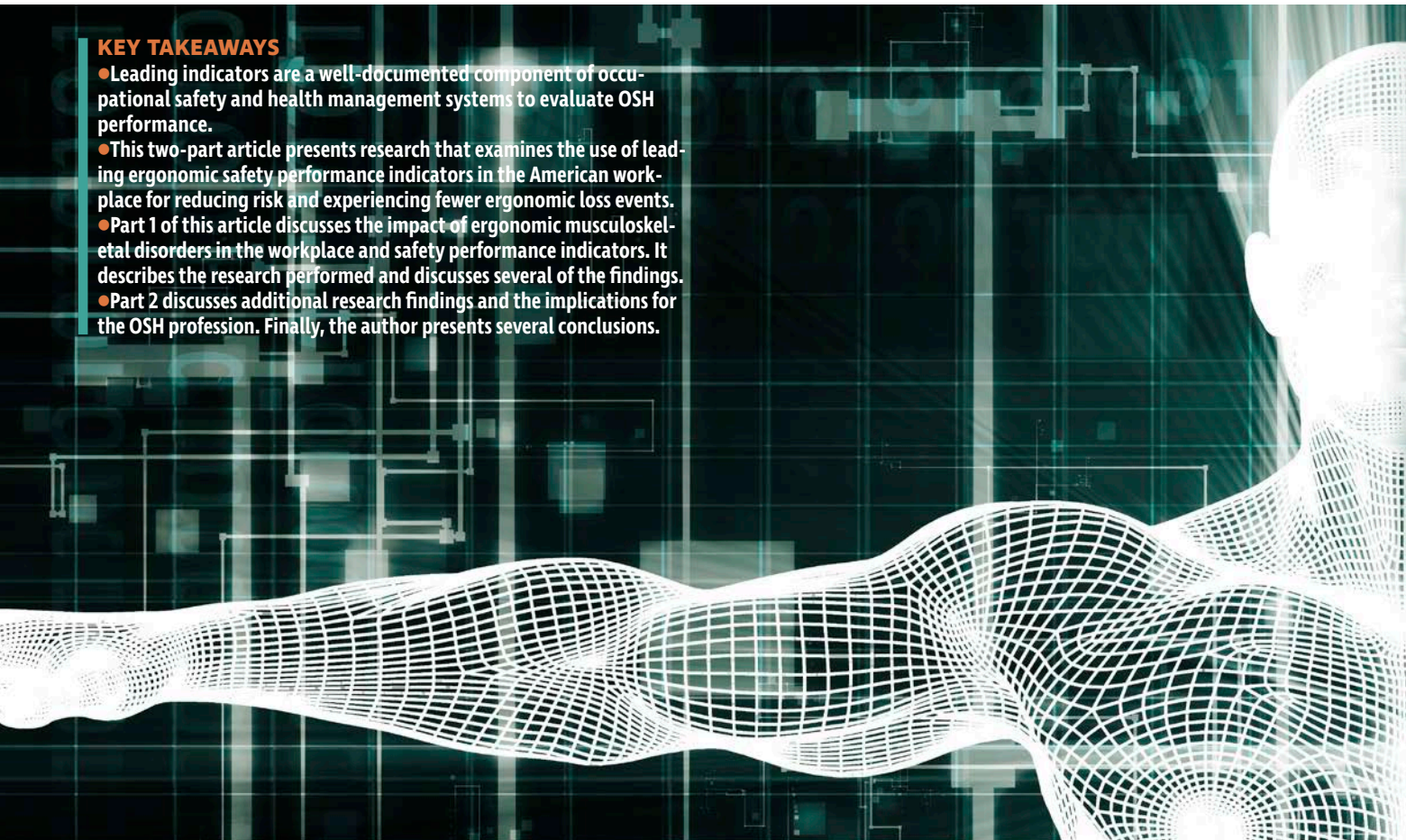

KEY TAKEAWAYS

- Leading indicators are a well-documented component of occupational safety and health management systems to evaluate OSH performance.
- This two-part article presents research that examines the use of leading ergonomic safety performance indicators in the American workplace for reducing risk and experiencing fewer ergonomic loss events.
- Part 1 of this article discusses the impact of ergonomic musculoskeletal disorders in the workplace and safety performance indicators. It describes the research performed and discusses several of the findings.
- Part 2 discusses additional research findings and the implications for the OSH profession. Finally, the author presents several conclusions.

OMIC INDICATORS
merican Workplace, Part 1

cious application of leading OSH indicators results in effective OHSMS, reduced risk and fewer occupational loss events (Manuele, 2014a; Petersen, 2005; UL, 2013).

This research anticipated that measuring the degree of EMCP (and OHSMS) implementation via tracking leading indicators, traditionally known as key performance indicators, would enable OSH professionals to evaluate the effectiveness of their OSH efforts in an ongoing manner and forecast pending shortcomings requiring OSH intervention. For this original research, the study incorporated 10 leading ergonomic indicators for consideration by survey respondents.

This study uses the term *SPI*. It proposes that the amplified acceptance of the SPI terminology would better equip the OSH professional to adapt to the ISO 45001 standard. The growing global importance of the OSH profession and the impact of ISO 45001 merit the general reception of this terminology in addition to an increased value and application of leading SPIs.

Since tracking leading SPIs is an expected component of certification-compliant OHSMS, this research suggests that the use of leading ergonomic SPIs would not only reduce risk and occupational ergonomic losses, but also may increase the use and certification of effective OHSMS across the globe and further reduce occupational risk overall. Hence, while the focus of this study was the degree of ergonomic SPI implementation, it is intended that the results will support the global use of leading SPIs and adoption of effective OHSMS.

OSH professionals require fluid education on this topic if they are to be empowered to take advantage of leading SPIs, EMCPs, OHSMS and their associated benefits to the global worker. In the absence of increased implementation of recommended SPIs within OHSMS (Table 1, p. 62), efforts for improved workplace safety in the global supply chain may continue to stall. Fortunately, OSH professionals are poised to take full advantage of SPIs, EMCPs and OHSMS through their clear understanding of the benefits and opportunities for their implementation.

The significant loss of life, serious injuries and illnesses, and dollars lost in the global workplace due to broken OSH management systems, unsafe practices and unsafe conditions along

TABLE 1
POTENTIAL SPIs BY OHSMS SECTION

Program element	Leading indicators	Lagging indicators
Management support and accountability	•percentage of goals/objectives incorporating OSH; •percentage of jobs preplanned; •average number of corrective actions per submission (incidents, near-hits, observation, inspections).	•percentage of projects that work without incidents; •documented meetings, metrics used compared to plan (positive or negative); •preplan verified and on site; •participation in OSH meetings, OSH budgets, OSH metrics communicated.
Employee participation and involvement	•percentage of employees involved in OSH decision-making process; •percentage of workforce submitting safe or at-risk behaviors weekly; •tracking percentage increase/decrease in number of submissions by the workforce.	•number of work method changes.
New hire orientation, training and learning	•percentage of employees trained prior to start of work; •percentage of employees/management trained.	•number of incidents related to training; •percentage of training on time following observation or incident; •number of training classes conducted.
Inspections/audits/observations	•number of inspections and observations; •percentage of compliant/safe conditions; •percentage of deficiencies; •percentage of severe/imminent of risk severity index; •percentage completion of corrective actions within timeline.	•near-hits; •incident rate (frequency and severity); •loss costs.
Incident, near-hit and observation investigations	•average time to complete investigations; •root cause(s) for loss identified; •number of near hits investigated/tracking; •number of observations investigated/tracking.	•repeat incident types or offenders.
Performance management systems/safety related	•percentage of performance reviews measuring success in achieving results; •number of inspections compared to individual objective; •number of OSH meetings conducted compared to individual objective; •number of one-on-one contacts; •percentage of losses tied to projects and individual objectives.	•near-hits; •incident rate (frequency and severity); •loss costs; •percentage of overall rating related to OSH performance/metrics; •project profitability.

Note. Adapted from "Using Leading and Lagging Safety Indicators to Manage Workplace Health and Safety Risk," by Underwriters Laboratories, 2013, Northbrook, IL: Author.

with the proven benefits ascribed to EMCPs and OHSMS in preventing such losses make this topic worthy of consideration, discussion and further research.

Impact of Ergonomic MSDs in the Workplace

Gaining a greater working knowledge of costly musculoskeletal disorders (MSDs) and other ergonomic loss events upon the American work environment better prepares OSH professionals to seek their reduction and eventual prevention via effective EMCPs, OHSMS and robust safety/risk performance measures.

> Work-related musculoskeletal disorders are the most widespread occupational health hazard facing our nation today. Nearly 2 million workers suffer work-related musculoskeletal disorders every year, and about 600,000 lose time from work as a result. . . . In addition, $1 of every $3 spent on workers' compensation stems from insufficient ergonomic protection. The direct costs attributable to MSDs are $15 to $20 billion per year, with total annual costs reaching $45 to $54 billion. (Jeffress, 2000)

Manuele (2014b) further elaborates:

> It is well established that successfully applied ergonomics initiatives result not only in risk reduction but also in improved productivity, lower costs and waste reduction. Furthermore, musculoskeletal injuries are a large segment of injuries and illness in all organizations. Since they are costly, reducing their frequency and severity will show notable results. (Manuele, 2014a, p. 289)

MSDs include disorders of the muscles, tendons, nerves, ligaments, joints, cartilage and spinal discs, except those hazardous

occurrences caused by slips, trips, falls, motor vehicle collisions or other similar trauma loss incidents (OSHA, 2003). Occupational ergonomic risk factors may include force, repetition, posture, vibration, contact stress and environmental stress (Bird, et al., 2003).

Exposure to these known risk factors for MSDs increases a worker's risk of injury (OSHA, 2016).

Ergonomic Risk Treatments

Work-related MSDs can be prevented. The science of ergonomics may be viewed fundamentally as fitting a job to a worker rather than forcing the employee into unhealthy work conditions. Deferring to ANSI/ASSP (2017), Bird, et al. (2003), and OSHA (1993), the following ergonomic intervention strategies and related risk treatments should be accomplished or attempted in the order of the following seven-step ergonomic risk treatment hierarchy.

1) Avoidance. Preventing the hazard from occurring by engaging prevention through design risk analysis for new operations or utilizing management of change risk analysis when contemplating modifications to an existing process, procedure, service or product.

2) Eliminate. Removing the hazard altogether, such as by eradicating dangerous machinery, modifying workstations or moderating temperature extremes.

3) Substitution. Replacing the material/process with something less hazardous, such as replacing 75-lb bags of flour in a bakery with 25-lb bags.

4) Engineering controls. Job modification by the use of new or modified tools, workstations, equipment or environmental controls.

5) Warnings. Alerting workers to the hazards, such as through signs, audible alarms, training or verbal instructions.

6) Administrative controls. Changing work processes, such as job rotation, workload distribution or work time changes.

7) Behavioral controls. Modification of work behaviors, such as having employees perform warm-up exercises, taking stretch breaks, striving for proper work postures and correct material handling techniques.

Safety Performance Indicators

Segueing from ergonomics into SPIs, leading indicators or lagging indicators specific to OSH efforts within an OHSMS are typically utilized in evaluating past OSH efforts and predicting future OSH performance. For decades, OSH professionals have struggled with measuring and evaluating their functional performance. On the subject, Petersen (2005) says, "The measurement of safety performance is, I believe, the [OSH] industry's most serious problem, and it has been a stumbling block for many years. The measures we have used traditionally are often not reliable and thus invalid."

Many esteemed OSH colleagues have presented valuable definitions and theories of SPIs over the years (Table 2, p. 64). Table 3 (p. 65) further presents the key differences between the traditional definitions of lagging and leading indicators.

> Companies and safety professionals have developed a number of these [SPIs] with no real understanding as to how well they measure safety performance, the types of interventions that are most effective in creating change in improving the [SPIs], and what appropriate methods should be used to determine if the [SPIs] are adequate. (Janicak & Ferguson, 2009)

Often to survive, OSH professionals must be able to justify whether their EMCPs and OHSMS are making a positive impact on the organization, confirm that they are meeting OSH goals, and communicate the status of OSH performance to the organization (Janicak, 2010). Developed around the current context of the organization, corporate strategies and key business goals, leading SPIs allow organizations to steward available resources effectively.

SPIs are known in the OSH profession by many names. Competing with the interchangeability of SPI terminology are the many definitions and theories of lagging and leading SPIs that have matured over the years and present themselves in current OSH literature. Manuele (2013) comments, "A uniform definition of leading indicators has not yet emerged, although the definitions being touted have the same base."

Lagging Indicators

While entrenched within the OSH profession, lagging SPIs have their ancillary place in an OSH performance measurement process. Alone, they are poor at providing valuable insight to prevent future loss events. Regrettably, tracking lagging SPIs alone summarizes only past loss experience and OHSMS failures. Lagging SPIs do not predict future OSH success, they merely illuminate upheavals in the OSH systems.

> The devastating incident with the *Deepwater Horizon* oil rig, where 11 workers lost their lives in April 2010, unfortunately, helps make this point. According to reports, "The very day of the blast on the rig, executives were aboard celebrating its 7 straight years free of serious accidents." I don't know what data that group was using to manage their risk levels, but if they were using incidents, then they had no data. Once a company reduces its incident rate to a low level, similar to the *Deepwater Horizon*, they run out of lagging data to analyze and have to turn to other data points, like leading indicators, to ensure continued low incident rates. (Schultz, 2012)

Current research in the OSH profession demonstrates the limitations of lagging indicators and the overpowering potential of leading indicators.

> Leading or upstream indicators are measures that allow you to anticipate and predict. They provide a precursor to any degradation in the safety process, enabling early management intervention. Lagging or downstream indicators are those metrics for events and conditions that already happened (or didn't happen). (Kaufman, 2009)

Kaufman (2009) astutely illuminates the SPI road ahead: "Leading indicators can give us the insight and predictive power to drive our organizations while looking through the windshield rather than the rearview mirror."

Leading Indicators

Leading SPIs have been employed and tracked since at least 1985, when the International Association of Oil and Gas Producers (OGP, 2013) began collecting safety incident statistics from its global member companies, providing trend analysis, benchmarking, and the identification of areas and activities on which OSH efforts should be focused to bring about the greatest improvements in performance to reduce loss events. Janicak (2010) discusses today's safety performance:

TABLE 2

CURRENT OSH INDUSTRY SPI DEFINITIONS

Definitions of Lagging SPIs

- **"Lagging indicators are measurements linked to the outcome of loss events" (Manuele, 2013, p. 283).**
- **"Lagging indicators are the traditional safety metrics used to indicate progress toward compliance with safety rules" (Middlesworth, 2014).**
- **"Lagging safety indicators . . . are historical metrics such as accident reports and statistics representing the traditional approach to measuring safety" (Telogis, 2015).**
- **"Outcome measures reflect the company's key safety objectives. [These measures, sometimes called] lagging indicators, typically demonstrate the final results of the safety process and measure safety performances that are the result of an activity" (Janicak, 2010, p. 7).**
- **"Trailing or lagging safety indicators are after-the-fact indicators which measure events or consequences that have occurred. These events or consequences are often associated with unwanted events, such as injuries, illnesses, workers' compensation costs, hospital visits, notices of violation, regulatory fines and litigation costs" (Wachter, 2012, p. 48).**
- **"Lagging metrics [are] a retrospective set of metrics that are based on incidents that meet the threshold of severity that should be reported as part of the industry-wide process safety metric" (CCPS, 2011, p. 4).**

Definitions of Leading SPIs

- **"Leading indicators are those safety activities that favorably impact on lagging indicators, are a precursor to safety degradation for early management reaction and validate the financial business case for the OSH efforts being accomplished" (Manuele, 2013, p. 279).**
- **"[Leading indicators] are a measure preceding or indicating a future event used to drive and measure activities carried out to prevent and control injury" (Middlesworth, 2014).**
- **"Leading indicators are predictive, measuring safety activities people are doing today that may prevent illness or injury tomorrow" (Petersen, 2005, p. 2).**
- **"Activity measures monitor the performance of activities that are needed to reach key objectives. These measures, sometimes called leading indicators, typically demonstrate the state of work-in-progress in terms of cost, quality and time . . . and are measures of the activity prior to the outcome" (Janicak, 2010, p. 24).**
- **"[Leading indicators] are an alternative approach to performance management — [focusing] on efforts to anticipate issues before they occur or grow in size and complexity" (Daniels, 2015).**
- **"Leading indicators proactively draw attention to specific behaviors and activities — thereby enabling employees and managers to modify behaviors before incidents or accidents occur" (Hohn, 2016).**
- **"[Leading indicators] offer promise as an improved gauge of OSH activity by providing early warning signs of potential failure and, thus, enabling organizations to identify and correct deficiencies before they trigger injuries and damage" (Sinelnikov, Inouye & Kerper, 2015, p. 241).**
- **"Leading indicators are used to focus resources on preventive actions. They allow management to actively demonstrate commitment and leadership, enable workers to get involved with measurable processes, and focus resources on accident prevention processes" (Toellner, 2001, p. 47).**
- **"[Leading metrics are a] forward-looking set of metrics which indicate the performance of the key work processes, operating discipline or layers of protection that prevent incidents . . . providing an early indication of deterioration in the effectiveness of key safety systems, and enable [remediation] to be undertaken to restore the effectiveness of these key [safety] barriers before any loss event takes place" (CCPS, 2011, pp. 4, 28).**

> Safety performance is now measured with the same tools and techniques common to quality control measures of other measures in the organization. Control charts, run charts and Pareto diagrams can be used to track and monitor safety performance, establish trends and evaluate program performance against accepted tolerances. (p. 2)

A white paper from Campbell Institute (2013) provides eight credible characteristics of leading SPIs: 1) actionable; 2) achievable; 3) meaningful; 4) transparent; 5) easy to communicate; 6) valid; 7) useful; and 8) timely. The white paper also affords the following agreed-upon enablers and barriers common to SPIs:

> Key enablers of successful leading indicator implementation and use:
>
> •executive buy-in on (not technical knowledge of) leading indicators;
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> •roll-up and use of leading indicators at the corporate level;
>
> •communication and understanding of the predictive value of leading indicators by EHS and corporate leadership;
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> •targeted leading indicator data collection used to analyze specific measurable actions rather than collected before development of response actions [i.e., preloss].
>
> Common barriers to successful leading indicator implementation and use:
>
> •absence of [OSH coordinator] education on the value and use of leading indicators;
>
> •inability to develop consistently actionable leading indicators;
>
> •lack of reliable, consistent relationship between leading and lagging indicator performance;
>
> •sporadic, infrequent and nonstandardized benchmarking;
>
> •continuing top management reliance on traditional lagging indicators. (Campbell, 2013, p. 2)

Research Findings

The purpose of this research study was to evaluate the following:

1) Whether the on-site OSH coordinator was influenced to utilize leading ergonomic SPIs based on his/her:

- job classification;
- educational level;
- personal scoring of the 10 proposed leading ergonomic SPIs.

2) Whether the lack of SPI education or experience by the OSH coordinator or the lack of management support were perceived as barriers to implementing leading ergonomic SPIs.

3) Whether the overall averaged SPI scores by OSH coordinator job classification significantly differs between the four job classifications.

To achieve these goals, the author developed a survey instrument to conduct the study organized around OSHA's (2015) seven constructs of an effective ergonomic management framework: 1) top management support; 2) affected worker involvement; 3) training/education; 4) ergonomic hazard identification (e.g., job hazard analysis, JHA); 5) implementation of solutions to control ergonomic hazards; 6) early reporting of MSD symptoms; 7) evaluate progress of corrective actions to reduce risk.

The instrument resulted in 10 leading ergonomic SPIs for respondents to consider regarding their ranking of importance, degree of implementation in the workplace and potential barriers to implementation:

1) measuring workers' perceptions of top/line management commitment to ergonomics safety (e.g., safety perception survey);

2) tracking the number of new hires being trained in ergonomics safety before the assignment of their work duties;

3) tracking the number of new hires assigned an OSH mentor to coach them in avoiding the ergonomic hazards of their work duties;

4) tracking the use of prehazard controls to avoid ergonomic hazards (e.g., prevention through design and/or management of change);

5) tracking the number of JHAs conducted to avoid ergonomic hazards;
6) measurement of workers' early reporting of strains/sprains they experience (e.g., ergonomic symptoms survey);
7) measuring worker participation in management-led stretch-and-flex exercises;
8) measuring ergonomic losses investigated for root causes within 24 hours;
9) measuring ergonomic improvements implemented;
10) conducting an annual audit of the written EMCP.

A targeted population of OSH professionals in the U.S. was surveyed within the higher MSD-risk trades of construction, healthcare, manufacturing, educational and services. E-mail requests were sent to 4,721 members of ASSP in the U.S., asking them to participate in this research. A total of 224 respondents replied to the survey from Jan. 30, 2017, to Feb. 15, 2017, for a response rate of approximately 5%. Forty-eight survey submissions were rejected due to incomplete responses, which resulted in 176 valid cases for analysis.

Descriptive Statistics

The researcher summarized each variable in this study with appropriate descriptive statistics to analyze the data such that, for example, patterns might emerge from the survey results. Descriptive statistics simply describe results. Inferential statistics allow us to infer, or make conclusions, beyond the data analyzed or reach conclusions regarding any hypotheses presented prior (Laerd, 2016a).

Inferential Statistics

While descriptive statistics provide information about the immediate group of data, we do not have access to the entire population of OSH professionals, but only a limited number of respondents. Inferential statistics are techniques to overcome sampling error in the data samples and allow generalization regarding the population of OSH coordinators. Hence, it is necessary that the sample accurately represents the population (Laerd, 2016a). Inferential statistics employed in this research include:

•Mann-Whitney U test. According to Laerd (2016b), "the Mann-Whitney U test compares differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed." For the variables, median scores were used and compared those who use the SPI to those who do not use the SPI (survey items 1.1 to 1.10 and items 2.1 to 2.10).

•Kruskal-Wallis test. According to Laerd (2016c), "the Kruskal-Wallis Test is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable." For the variables, the study sought to determine the mean scores of the perceived importance of SPIs based on job classifications (survey items 1.1 to 1.10 and item 4). Follow-up Dunn-Bonferroni tests were performed to examine pairwise comparisons. The researcher also sought to determine the mean ranking of how survey respondents rank SPI items by their level of education (survey items 1.1 to 1.10 and item 5).

•Chi-Square for Goodness-of-Fit Test. According to Laerd (2016d), "the Chi-Square for Goodness-of-Fit Test is a single-sample nonparametric test used to determine whether the distribution of cases in a single categorical variable follows a known or hypothesized distribution." The researcher sought to determine the respondents' perceived difficulties in implementing leading ergonomic SPIs (survey items 2.1.1 to 2.10.10).

TABLE 3
KEY DIFFERENCES BETWEEN SPIs

Lagging/Reactive SPIs	Leading/Proactive SPIs
1) Are retrospective.	1) Are actionable, predictive and relevant to objectives.
2) Identify hazards after they occur.	2) Identify hazards before they occur.
3) Require corrective actions to prevent another similar incident.	3) Allow preventive actions before a hazard manifests as an incident.
4) Indicate that circumstances have changed; control measures can be implemented after the incident.	4) Allow response to changing circumstances through implementing control measures before an incident.
5) Measure failures of control systems.	5) Measure effectiveness of control systems.
6) Measure outcomes.	6) Measure inputs and conditions.
7) Measure current outcome without influencing it.	7) Direct toward a desired outcome or away from an undesired outcome.
8) Measure system failures.	8) Give indications of systems conditions.
9) Measure what has gone wrong.	9) Measure what might go wrong and why.
10) Provide reactive monitoring of undesired effects.	10) Provide proactive monitoring of the desired state.
11) Are useful for external benchmarking.	11) Are useful for internal tracking of performance.
12) Identify weaknesses through loss incidents.	12) Identify weaknesses through the risk control system.
13) Are easy to identify and measure.	13) Are challenging to identify and measure.
14) Are static.	14) Evolve as organizational needs change.

Note. Adapted from "Overview of Leading Indicators for Occupational Health and Safety in Mining," by International Council on Mining and Metals, 2012, London, England: Author.

•ANOVA procedure. According to Laerd (2016e), "the one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of two or more independent groups." The study sought to determine whether significant differences exist in the average of the overall SPI importance scores based on OSH coordinator job classification (total of survey items 1.1 to 1.10 and item 4).

IBM's SPSS version 24.0 was used to examine data from the study's results. Specifically, SPSS was applied in conducting Mann-Whitney U Tests, Kruskal-Wallis Tests, Chi-Square for Goodness-of-Fit Tests and ANOVA Procedures.

Research Variables

The first 10 survey questions (1.1 through 1.10) presented the following question: "How important are the following leading safety performance indicators (SPIs) for reducing ergonomic musculoskeletal disorders (MSDs) in your workplace?" These first 10 survey questions were ordinal and utilized a Likert scale, asking respondents to score the importance of the leading ergonomic SPIs on a five-point scale. The sum of the Likert scale items 1.1 to 1.10 was used to measure the overall importance scoring of leading indicators for further consideration of trends. Use of the Likert scale enabled the researcher to reduce complex responses into a sequence of ordinal numbers. Once inferential statistics were applied, a mean ranking score was utilized. The lower the mean ranking, the more importance the respondent was placing on the question item (e.g., scoring annual ergonomic audits as "very

important"). The higher the mean ranking, the less importance the respondent placed on that question (e.g., scoring ergonomic improvements implemented as "not at all important").

The second set of survey questions (2.1 through 2.10) presented the following question: "Over the past 3 years, has your company utilized the following leading SPIs aimed at reducing ergonomic MSDs in the workplace?" The second set of 10 questions were nominal with possible responses of "Yes," "No" and "Do not know." These items asked respondents if they use the listed leading ergonomic SPIs, mirroring the SPI constructs within the first 10 questions (1.1 through 1.10). Each of the survey questions 2.1 through 2.10 had a follow-up question if respondents answered "No," asking them to provide their perceived reason for the difficulty in implementing that leading ergonomic SPI. Possible replies to a "No" response for questions 2.1.1 through 2.10.10 included "Too costly," "Too difficult to implement," "Lack of management support," "New concept; not known prior" and "Other."

The third and fourth survey items asked respondents to, respectively, "Select the best OSH role of the person completing this survey" and "Select the best educational description of the person completing this survey."

The study pursued five major considerations regarding the use of leading ergonomic SPIs, including 1) perceived importance of leading ergonomic SPIs based upon use; 2) perceived importance of leading ergonomic SPIs by job classification; 3) perceived importance of leading ergonomic SPIs by education; 4) perceived difficulties in implementing leading ergonomic SPIs; and 5) average overall leading ergonomic SPI importance scores by job classification.

Perceived Importance of Leading Ergonomic SPIs Based on Use

The study sought to determine whether significant differences exist in the perceived levels of importance of leading ergonomic SPIs based on whether they were being used. To determine this, the perceived importance of each SPI was examined in this study, as was the extent to which they were being used.

Respondents generally scored all the provided leading ergonomic SPIs toward the "very important" end of the scale. SPIs scored most frequently as "very important" were workers' early reporting of ergonomic strains and sprains they experience (68.6 %), use of prehazard ergonomic controls to avoid ergonomic hazards (59.8 %) and ergonomic improvements implemented (58.5 %). Nearly 60% of respondents reported the most frequently used leading ergonomic SPI was measurement of workers' early reporting of ergonomic strains and sprains they experience. However, a noted area of concern is that for those familiar with the SPIs being tracked in the workplace, about 65% indicated that for all SPIs examined in this study, they were not being used. This finding demonstrates that using SPIs examined in this study to improve ergonomics in the workplace is not a widely accepted practice.

One SPI, the monitoring of the number of new hires assigned an OSH mentor to coach them in avoiding ergonomic hazards of their work duties, was perceived differently by those who use it compared to those who do not. Respondents who use this indicator rated it significantly more important than those who do not use it (Mann-Whitney $U = 3{,}351$, $p < .05$). It appears that OSH coordinators value the importance of the mentorship concept, likely due to their knowledge of a positive experience with this leading ergonomic SPI. This finding could be used to encourage OSH professionals who have not done so to consider applying the use of mentors in the workplace for orienting new hires to the hazards of MSDs (and other OSH exposures) in their new work setting.

Perceived Importance of Leading Ergonomic SPIs by Job Classification

The study sought to determine if significant differences exist in whether the job classifications of OSH coordinators influenced their perceived importance of leading ergonomic SPIs. To determine this, the perceived importance of each SPI was evaluated by the job classification of the OSH coordinator.

About 90% of study respondents classified themselves as "full-time" (50% or more of job duties and time dedicated to OSH), while those who classified themselves as "part-time" (less than 50% of job duties and time dedicated to OSH), "other" and "human resources" made up 4%, 4% and 2% of respondents, respectively. Due to the overrepresentation of the full-time group and an underrepresentation of the other three, conclusions cannot be drawn from the results.

Perceived Importance of Leading Ergonomic SPIs by Education

The study sought to determine whether significant differences exist in how OSH coordinators would rate the perceived importance of leading ergonomic SPIs based on their reported level of education. To determine this, the perceived importance of each SPI was examined by the education of the OSH coordinator.

About 61% ($N = 82$) of respondents classified themselves as having a "college degree in safety and health or a related scientific field of study," about 29% ($N = 29$) as having a "college degree other than safety and health or a related scientific field of study" and approximately 10% ($N = 14$) as having "no college degree." This study found significant differences in two areas.

First, in valuing workers' perceptions of top/line management commitment to ergonomics safety, those OSH coordinators with a college degree (i.e., both groups "college degree in safety and health or a related scientific field of study" and "college degree other than safety and health or a related scientific field of study") placed less importance on this leading ergonomic SPI than respondents with no degree (Kruskal-Wallis = 7.86, $p < .05$ and Dunn-Bonferroni = 26.7, $p < .05$). This outcome was not expected. As their formal college education is factored in, the OSH coordinators with a college degree may have more knowledge about how to manage an EMCP and, as a result, are more secure in what they are doing and less dependent on management commitment to accomplish their OSH responsibilities. Additional research would be beneficial to determine why this difference exists.

The second significant finding was that OSH coordinators classified as having an education level of "no college degree" placed more importance on ergonomic losses investigated for root causes within 24 hours than did the other two educational classifications (Kruskal-Wallis = 8.05, $p < .05$ and Dunn-Bonferroni = 28.59, $p < .05$). Further questions to pursue beyond this study may include whether one education category performs more or fewer ergonomic loss incident investigations, thereby allowing that category to become more comfortable with the concept and have positive experiences in viewing the benefits. Lastly, perhaps nondegreed respondents are more likely to be part-time and, as such, work on the floor with greater exposure to workplace hazards. This exposure may produce an appreciation for preventing future loss events via ergonomic loss investigations and root cause analysis. Additional research is required to determine why this difference exists.

Contrary to what was anticipated, eight of the 10 leading ergonomic SPIs presented no significant differences in perceived importance ratings by the respondents based on their education level. The author concluded there is no link between a respondent's education level and what they perceive to be important in relation to the leading ergonomic SPIs presented in this study.

In the Next Issue

Part 1 of this article presented here discusses the impact of ergonomic MSDs in the workplace and SPIs. The author describes the research performed and discusses several of the findings. In part 2, the author discusses additional research findings and the implications for the OSH profession. Finally, the author presents several conclusions. **PSJ**

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