

# LEADING ERGONOMIC Their Importance in the American Workplace

By Fred Straub

**PART 1 OF THIS ARTICLE**, presented in the October 2018 issue (*PS*, pp. 60-67), discusses the impact of ergonomic musculoskeletal disorders (MSDs) in the workplace and safety performance indicators (SPIs). The author describes the research performed and discusses several of the findings. Part 2 presented here discusses additional research findings and the implications for the OSH profession. Finally, the author presents several conclusions.

As noted in Part 1 of this article, this study asked respondents to consider 10 leading ergonomic SPIs 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 pre-hazard controls to avoid ergonomic hazards (e.g., prevention through design and/or management of change);

5) tracking the number of job hazard analyses (JHA) 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 ergonomic management control programs (EMCP).

## Perceived Difficulties in Implementing Leading Ergonomic SPIs

This study sought to determine whether significant differences exist in the perceived difficulties or barriers OSH coordinators experience in implementing leading ergonomic SPIs. The study anticipated that most OSH coordinators would identify a lack of familiarity with the leading ergonomic SPIs (i.e., new

### 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.



# ERGONOMIC INDICATORS in the American Workplace, Part 2

concept) or a lack of management support. To validate this, the research study examined respondents' perceived barriers to implementation for each SPI examined in this study.

The study's statistical findings support the prediction regarding significant differences in the perceived difficulties or barriers that OSH coordinators experience in implementing leading ergonomic SPIs. The chi-square research results determined eight of the 10 leading ergonomic SPIs had significantly different frequencies of responses than expected ( $p < .05$ ). Of the survey's 10 SPIs, only tracking the use of prehazard controls to avoid ergonomic hazards and measuring ergonomic improvements implemented failed to produce significantly different frequencies of responses.

Lack of management support was the most frequently selected barrier for four of the eight significantly different leading ergonomic SPIs presented in the study and tied with the new concept barrier for a fifth SPI. The percentage of respondents citing lack of management support for these SPIs ranged from 28.3% to 38.8%. Theorizing on the impact that lack of management sup-

port may have on respondents' tracking the leading ergonomic SPIs in question, let's review each of these five designated SPIs.

First, lack of management support was identified as a leading barrier for the SPI involving the measurement of workers' perceptions of top/line management commitment to ergonomics safety. Failure to track this leading ergonomic SPI blinds management from knowing to what extent compliance is achieved. If in full compliance, and management does not support the completion of worker OSH perception surveys, the employer may not learn of workers' positive OSH climate. Unnecessary OSH budgets may then be expended to improve worker perception when such a need does not exist. Further, failure to track this SPI due to a lack of management support may hide the resulting fact that no worker OSH perception surveys are conducted. This, in turn, may fail to warn management of low worker morale and a substandard OSH climate, resulting in poor worker performance and potentially increase the risk for ergonomic losses.

Second, lack of management support was identified as a leading barrier for the SPI involving tracking the number of JHAs conducted



to avoid ergonomic hazards. The decision not to support and track this leading ergonomic SPI bars management from determining the SPI's actual level of compliance within the organization. If JHAs are indeed being produced and tracked but the employer fails to support tracking the number completed, management loses its ability to gain an overall perspective on the connection between JHA completion and the organization's reduction in ergonomic loss cases. If JHAs are being conducted and a corresponding reduction in the lagging indicator of recordable ergonomic injuries does not occur, the employer can reevaluate whether training for those performing JHAs is adequate to identify ergonomic risk factors and produce effective ergonomic risk treatments. At the other end of the compliance scale, failure to support tracking JHAs has the possible consequence of management's failure to maintain the plan-do-check-act (PDCA) cycle of the EMCP and occupational health and safety management systems (OHSMS). For example, management's decision not to allow the completion and annual review of JHAs may thereby fail to accomplish the plan and check phases of the PDCA loop.

Third, lack of management support was identified as a leading barrier for the SPI involving measurement of workers' early reporting of strains/sprains they experience. Incidentally, this leading ergonomic SPI was one of the top three SPIs respondents scored as "very important." Determining this SPI's actual level of compliance in an organization provides management with data for formulating a response to reduce the risk of future ergonomic losses. Lack of management support for tracking the reporting of these early strains and sprains may fail to inform the employer that early reporting of strains and sprains is indeed accomplished. Again, if a corresponding reduction in the lagging indicator of recordable ergonomic injuries is not evident, the employer can reevaluate whether the current employee ergonomic symptoms survey is adequate to identify adverse ergonomic risk factors. If management support for tracking this SPI is not present and the OSH coordinator is not tracking early reporting, then the employer would not know if ergonomic loss potentials exist and would be less likely to perform facility-wide ergonomic symptoms surveys in a timely manner. Perhaps instead, the reactionary management decision would dictate waiting for ergonomic loss events to occur, then developing risk treatments to prevent recurrence. This posture could result in a significant number of ergonomic loss events that could have been identified in the early stages by encouraging workers to report strains and sprains early in the process.

Fourth, lack of management support was identified as a leading barrier for the SPI involving the measurement of worker participation in management-led stretch-and-flex exercises. Failure to track this leading ergonomic SPI prevents the employer from ascertaining whether compliance is accomplished. If the employer elects not to support tracking this SPI, management loses the ability to make effective OSH decisions. For example, if the employer complies with tracking worker participation in the stretch-and-flex process yet fails to utilize this SPI due to limited corporate funding for tracking, the employer may not observe that only 32% of workers are participating. At the other end of the spectrum, the consequence of management's failure to support tracking this SPI could hide from their view that middle management refuses to take on the leader role for these stretch-and-flex exercises. Such an attitude can convey a negative message to the workforce that the stretch-and-flex program, the EMCP and the company's OSH efforts overall exist only for the production personnel and are unimportant to the management levels. This management attitude can poison an organization's OSH climate and may result in additional occupational risk and unnecessary ergonomic loss events.

Fifth, lack of management support tied with new concept as a leading barrier for the SPI involving tracking the number of new hires being trained in ergonomics safety before the assignment of their work duties. Without tracking this SPI, employers could be unaware of their level of compliance. If the lack of management support prevents this tracking, management may not be informed that new hires are indeed being trained in ergonomics safety before the assignment of their work duties. If a reduction in the work site's recordable ergonomic injuries does not then correspond with the successful training of new hires in ergonomic safety and SPI tracking does not occur, management may fail to conclude that an audit and evaluation of the effectiveness of the company's ergonomic training curriculum are warranted. Subpar ergonomics training for new hires could thereby persist and result in unacceptable risk for additional ergonomic losses. From the standpoint of noncompliance, the consequence of management's failure to track this SPI could present a misconception that new hire training is provided when it is not. This outcome may result in an elevated number of new hires experiencing ergonomic-related injuries.

These results addressing the lack of management support mirror the findings from the literature review on the importance of top/middle management support and commitment for OSH efforts (UL, 2013) and sustain the prediction that a lack of management support would be identified as a primary barrier.

New concept was identified as a leading barrier for the SPI involving tracking the number of new hires assigned an OSH mentor to coach them in avoiding the ergonomic hazards of their work duties. Lack of knowledge regarding this SPI may prevent the employer from determining whether its use of OSH mentors is being implemented effectively. Management may thereby lose the ability to determine that a lack of familiarity with mentoring programs or the successes being realized may prevent full utilization of this SPI by all departments. Failure to track this SPI may result in an employer's inability to identify possible zero compliance with ergonomics mentoring. Digging deeper, management may determine that the OSH coordinator lacks a perceived value in the importance of mentorship due to his/her lack of familiarity with the concept regarding this leading ergonomic SPI.

As noted, the new concept barrier tied with lack of management support for the SPI involving tracking the number of new hires being trained in ergonomics safety before the assignment of their work duties. A lack of familiarity about this leading ergonomic SPI may place it off the OSH coordinator's radar of SPIs to track. The result could be absence of information as to whether new hires are being trained in ergonomics safety before the assignment of their work duties. If ergonomics training is indeed conducted and the employer fails to track and record this success, management may not recognize an association between new hire training and ergonomic losses. Failure to track this SPI may hide the fact that the employer is not conducting this training in a timely manner.

Overall, these two findings about the new concept barrier support the researcher's opinion that a lack of familiarity with the topic of leading ergonomic SPIs would be identified as a primary barrier to implementation. Educating today's OSH professionals on the benefits, design and implementation of leading ergonomic SPIs in both the academic and nontraditional educational spheres could produce a positive change and increased SPI use.

Too costly was the least frequently selected barrier for the eight significant leading ergonomic SPIs presented in the study. This may be viewed as a positive note. The author finds that implementing and tracking leading SPIs involves a minor cost to the employer. Yet, these SPIs can reap significant rewards in reduced risk and fewer loss events.

The study also found significant differences in the perceived difficulties or barriers OSH coordinators experience in implementing leading ergonomic SPIs. When assembling OSH performance measurement programs and developing leading ergonomic SPIs, OSH coordinators should give attention to the lack of management support barrier. Failure to avoid this common barrier to SPI implementation may risk the success of the SPI and ultimately the success of the specific OSH effort it is tracking.

### Average Overall Leading Ergonomic SPI Importance Scores by Job Classification

The study sought to determine whether significant differences exist in the overall average leading ergonomic SPI importance scores by OSH coordinators' job classification. The study predicted that full-time OSH coordinators (50% or more of job duties and time dedicated to OSH) would present consistently higher average overall scores of the leading ergonomic SPIs than the other three job classifications [part-time OSH coordinators (less than 50% of job duties and time dedicated to OSH), human resources and other] due to their education and favorable on-the-job experiences. To determine this, the perceived importance ratings of each of the SPIs examined in this study were summed and the means compared across the job classifications.

As was the case with the Kruskal-Wallis test involving job classifications, due to an overrepresentation of the full-time group and an underrepresentation of the other three, conclusions cannot be drawn from the results.

### Implications for the OSH Profession

Ergonomic loss potentials in the occupational setting typically occur because of a failure to implement effective ergonomic risk treatments characteristically provided in a comprehensive EMCP. Hence, the researcher thought it prudent to investigate how to improve the use of leading ergonomic SPIs to evaluate the effectiveness of EMCPs and thereby potentially reduce ergonomic loss events. The author suggests that OSH professionals increase their application of the leading ergonomic SPIs presented in this study, while being mindful of the barriers to implementation discussed, primarily lack of management support and lack of knowledge regarding leading ergonomic SPIs.

Since EMCPs are a component of comprehensive OHSMS, the author proposes that the use of leading SPIs would be productive in evaluating the efficacy of EMCPs just as they have proven effective in evaluating OHSMS. About two-thirds of the companies represented in this study do not use leading ergonomic SPIs. This lack of leading SPI application may stem from lack of familiarity with leading ergonomic SPIs, lack of research or literature on the topic, absence of management support to implement leading SPIs at the work sites surveyed, entrenched use of lagging indicators or a combination of these. This study encourages additional research and education on the benefits of leading SPIs to increase their use in the OSH profession and among the nation's work sites.

Survey respondents generally valued the leading ergonomic SPIs presented in this study with a level of importance in reducing MSDs despite their minimal degree of implementation in the workplace. This favorability is encouraging and reflects the OSH profession's growing positive view of leading SPIs. This promising impression of leading SPIs in concert with additional research and education on the benefits of leading SPIs should increase the degree of leading SPI implementation.

Lack of management support was identified as a major barrier to implementing the use of leading ergonomic SPIs. Management's failure to support ergonomic SPIs and even other general OSH is-

ues can damage an OSH climate. According to Bird, et al. (2003), "People tend to use their leaders as models . . . wanting to please their leaders and do so by following their behavioral example." Management commitment is a requirement of the major OHSMS schemes and its absence will result in a struggle to achieve risk reduction (ANSI/ASSP, 2017; BSI, 2007; ILO, 2001; ISO, 2018; OSHA, 2016). The OSH profession should increase management awareness of the applicability and benefits of leading ergonomic SPIs. "Ultimately, the responsibility is with OSH professionals to equip senior management with the knowledge about leading indicators in order to increase their awareness, support and commitment to conducting rigorous evaluations of OSH performance" (Sinelnikov, Inouye & Kerper, 2015, cited by Janicak, 2015).

Cost was the least frequently identified barrier to implementing the leading ergonomic SPIs presented in this study. Therefore, the OSH profession should be encouraged that the perceptions of cost concerns not deter OSH professionals from pursuing leading SPIs. That said, OSH professionals must understand and function within the charge given to their top management, whereas economic performance is the first responsibility of their business (Manuele, 2013). Fortunately, the cost of implementing leading ergonomic SPIs is minimal and is far outweighed by the potential benefits of reduced or eliminated risk of ergonomic or other occupational loss events.

The study also identified lack of familiarity with the topic of leading ergonomic SPIs as a barrier to implementation. In the field of OSH, failure to educate affected line personnel adequately on the hazards and risk treatments of their occupations can produce disastrous results. Likewise, failure to educate OSH professionals in ergonomics, EMCPs, OHSMS and leading SPIs could create situations in which EMCPs and OHSMS operate at less than peak efficiency, resulting in missed OSH opportunities and possible loss events. More research, literature and education on leading ergonomic SPIs is recommended.

### Conclusion

Using leading SPIs has a proven history of evaluating the effectiveness of OHSMS to reduce risk (Manuele, 2014a; Petersen, 2005; UL, 2013). This study examined the perceived importance and implementation of SPIs related to ergonomics in the workplace and identified four major findings. First, OSH coordinators who use leading ergonomic SPIs generally perceive them as valuable. Second, the use of leading ergonomic SPIs in the workplace is not a widely accepted practice. Third, lack of management commitment and lack of knowledge about leading ergonomic SPIs are commonly perceived barriers to implementation. Fourth, there is no link between education and the perception of importance for leading ergonomic SPIs.

While the subject matter may be relatively new to many OSH coordinators, there is already a groundswell of understanding of the topic as demonstrated by the respondents participating in this study and the topic's mounting presence in OSH literature. This groundswell is driven by current OHSMS requirements for program evaluation within the primary OHSMS certification schemes utilized by major employers. At the time of this research, the five top-favored OHSMS models all promote the use of leading indicators to evaluate and predict OSH performance (ANSI/ASSP, 2017; BSI, 2007; ILO, 2001; ISO, 2018; OSHA, 2016). The author believes the growing pressure of OSH expectations on employers from the supply chain and the recent release of ISO 45001 will result in the OSH profession's increased use of leading ergonomic SPIs. Because EMCPs are a component of comprehen-

**Fred Straub, Ph.D., CSP, ARM**, is president and principal consultant of **Prospering Safely Safety and Risk Management Services LLC**. With more than 30 years of practical safety and health experience, he earned doctorate, master's and undergraduate degrees in safety sciences from **Indiana University of Pennsylvania**. Straub is a professional member and past president of **ASSP's Central Pennsylvania Chapter** and was named **ASSP Regional VIII Safety Professional of the Year in 1997**.

sive OHSMS, this research suggests that the use of leading SPIs would also be effective in evaluating the effectiveness of EMCPS.

Further educating today's OSH professionals in the benefit, design and implementation of leading SPIs in both the academic and nontraditional educational spheres will produce a positive change for increased SPI usage. The author believes this research has value to the OSH profession as it prepares for the coming decade of a risk-based approach utilizing OHSMS and leading SPIs, and observes a departure from a regulation-focused approach. In the future, OSH professionals will need to possess the analytical abilities required to manage an OSH performance measurement program, and the academic community will need to develop OSH curricula that include material pertaining to leading SPIs. The curricula should also include strategies that can be used to overcome the lack of management commitment to using these measures. Ultimately, such an effort may encourage greater use of leading ergonomic SPIs and further integration of SPIs into organizations' OHSMS, thereby allowing OSH professionals to achieve their mutual professional goals of reducing risk and achieving zero losses. **PSJ**

## References

- ANSI/ASSP. (2017). Occupational health and safety management systems [Z10-2012 (R2017)]. Park Ridge, IL: Author. Retrieved from <https://store.assp.org/PersonifyEbusiness/Store/Product-Details/productId/29237335>
- Bird, F., Germain, G. & Clark, D. (2003). *Loss control management: Practical loss control leadership* (3rd ed.). Duluth, GA: Det Norske Veritas.
- Blair, E. & O'Toole, M. (2010, August). Leading measures: Enhancing safety climate and driving safety performance. *Professional Safety*, 55(8), 29-34.
- British Standards Institute (BSI). (2007). Occupational health and safety assessment series (OHSAS 18001-2007). Herndon, VA: Author.
- Campbell Institute. (2013). Transforming EHS performance measurement through leading indicators (White paper). Itasca, IL: Author.
- Center for Chemical Process Safety (CCPS). (2011). Process safety leading and lagging metrics: You don't improve what you don't measure. Retrieved from [www.aiche.org/sites/default/files/docs/pages/CCPS\\_ProcessSafety\\_Lagging\\_2011\\_2-24.pdf](http://www.aiche.org/sites/default/files/docs/pages/CCPS_ProcessSafety_Lagging_2011_2-24.pdf)
- Daniels, D. (2015). Safety and health: Performance metrics—The value of leading and lagging indicators. Retrieved from [www.iafc.org/on-scene/on-scene-article/safety-health-performance-metrics-the-value-of-leading-and-lagging-indicators#sthash.YtNiI3u9.dpuf](http://www.iafc.org/on-scene/on-scene-article/safety-health-performance-metrics-the-value-of-leading-and-lagging-indicators#sthash.YtNiI3u9.dpuf)
- Hohn, J. (2016). Applying leading and lagging indicators to workplace safety programs. Retrieved from [www.workplacemagazine.com/Ezine/FullStory.aspx?EzineDataID=2404](http://www.workplacemagazine.com/Ezine/FullStory.aspx?EzineDataID=2404)
- International Association of Oil and Gas Producers (OGP). (2013). OGP safety performance indicators 2012 data (Report No. 2012s). Retrieved from [www.scribd.com/document/170049742/OGP-Safety-Performance-Indicator-Data-2012](http://www.scribd.com/document/170049742/OGP-Safety-Performance-Indicator-Data-2012)
- International Council on Mining and Metals (ICMM). (2012). Overview of leading indicators for occupational health and safety in mining. London, England: Author. Retrieved from [www.icmm.com/website/publications/pdfs/health-and-safety/4800.pdf](http://www.icmm.com/website/publications/pdfs/health-and-safety/4800.pdf)
- International Labor Organization (ILO). (2001). Guidelines on occupational safety and health management systems (ILO-OSH-2001). Geneva, Switzerland: Author.
- International Organization for Standardization (ISO). (2018). Occupational health and safety management systems (ISO 45001). Geneva, Switzerland: Author.
- Janicak, C. & Ferguson, L. (2009). Integrating safety performance measures into the safety management system (Session No. 712). Presentation at Safety 2009, San Antonio, TX. Retrieved from [www.onepetro.org/conference-paper/ASSE-09-712](http://www.onepetro.org/conference-paper/ASSE-09-712)
- Janicak, C. (2010). *Safety metrics: Tools and techniques for measuring safety performance* (2nd ed.). Lanham, MD: Government Institutes.
- Janicak, C. (2015). *Safety metrics: Tools and techniques for measuring safety performance* (3rd ed.). Lanham, MD: Bernan Press.
- Jeffress, C. (2000, Apr. 27). Presentation to the Subcommittee on Employment, Safety and Training of the Senate Health, Education, Labor and Pensions Committee. Retrieved from [www.osha.gov/news/testimonies/04272000](http://www.osha.gov/news/testimonies/04272000)
- Kaufman, J. (2009, June 11). Leading indicators point the way. *ISHN*. Retrieved from [www.ishn.com/articles/88257-leading-indicators-point-the-way](http://www.ishn.com/articles/88257-leading-indicators-point-the-way)
- Laerd Statistics. (2016a). Descriptive and inferential statistics. Retrieved from <https://statistics.laerd.com/statistical-guides/descriptive-inferential-statistics.php>
- Laerd Statistics. (2016b). Mann-Whitney U Test using SPSS statistics. Retrieved from <https://statistics.laerd.com/spss-tutorials/mann-whitney-u-test-using-spss-statistics.php>
- Laerd Statistics. (2016c). Kruskal-Wallis Test using SPSS statistics. Retrieved from <https://statistics.laerd.com/spss-tutorials/kruskal-wallis-h-test-using-spss-statistics.php>
- Laerd Statistics. (2016d). Chi-Square Goodness-of-Fit test in SPSS statistics. Retrieved from <https://statistics.laerd.com/spss-tutorials/chi-square-goodness-of-fit-test-in-spss-statistics.php>
- Laerd Statistics. (2016e). ANOVA Test using SPSS statistics. Retrieved from <https://statistics.laerd.com/spss-tutorials/one-way-anova-using-spss-statistics.php>
- Manuele, F.A. (2009, December). Leading and lagging indicators: Do they add to the practice of safety? *Professional Safety*, 54(12), 28-33.
- Manuele, F.A. (2013). *On the practice of safety* (4th ed.). Hoboken, NJ: John Wiley & Sons.
- Manuele, F.A. (2014a). *Advanced safety management: Focusing on Z10 and serious injury prevention* (2nd ed.). Hoboken, NJ: John Wiley & Sons.
- Manuele, F.A. (2014b, April). ANSI/AIHA/ASSE Z10-2012: An overview of the occupational health and safety management systems standard. *Professional Safety*, 59(4), 44-51.
- Middlesworth, M. (2014, Apr. 24). A short guide to leading and lagging indicators of safety performance. Retrieved from <http://ergo-plus.com/leading-lagging-indicators-safety-preformance>
- OSHA. (1993). Ergonomics program management guidelines for meatpacking plants. Retrieved from [www.osha.gov/Publications/OSHA3123/3123.html](http://www.osha.gov/Publications/OSHA3123/3123.html)
- OSHA. (2003, June 30). Occupational injury and illness recording and reporting requirements (29 CFR 1904). Retrieved from [www.osha.gov/laws-regs/federalregister/2003-06-30](http://www.osha.gov/laws-regs/federalregister/2003-06-30)
- OSHA. (2015). Ergonomics. Retrieved from [www.osha.gov/SLTC/ergonomics/index.html](http://www.osha.gov/SLTC/ergonomics/index.html)
- OSHA. (2016). Safety and health program management guidelines. Retrieved from [www.osha.gov/shpmguidelines/SHPM\\_guidelines.pdf](http://www.osha.gov/shpmguidelines/SHPM_guidelines.pdf)
- Petersen, D. (2005). *Measurement of safety performance*. Des Plaines, IL: ASSP.
- Schultz, G. (2012, June 18). Don't investigate safety incidents . . . predict and prevent them! *EHS Today*. Retrieved from <http://ehstoday.com/safety/don-t-investigate-safety-incidents-predict-and-prevent-them>
- Sinelnikov, S., Inouye, J. & Kerper, S. (2015). Using leading indicators to measure occupational health and safety performance. *Safety Science*, 72, 240-248.
- Straub, F. (2017). *The perceived importance and degree of implementation of ergonomics-related leading safety performance indicators in the American workplace* (Doctoral dissertation, Indiana University of Pennsylvania). ProQuest Dissertations Publishing. Retrieved from <https://search.proquest.com/docview/1898798003>
- Telogis. (2015). Lagging or leading: What safety indicators does your fleet use? Retrieved from [www.telogis.com/blog/lagging-leading-safety-indicators-fleet](http://www.telogis.com/blog/lagging-leading-safety-indicators-fleet)
- Toellner, J. (2001, September). Improving safety and health performance: Identifying and measuring leading indicators. *Professional Safety*, 46(9), 42-47.
- Underwriters Laboratories (UL). (2013). Using leading and lagging safety indicators to manage workplace health and safety risk (White paper). Retrieved from [https://library.ul.com/wp-content/uploads/sites/40/2015/02/UL\\_WP\\_Final\\_Using-Leading-and-Lagging-Safety-Indicators-to-Manage-Workplace-Health-and-Safety-Risk\\_V7-LR1.pdf](https://library.ul.com/wp-content/uploads/sites/40/2015/02/UL_WP_Final_Using-Leading-and-Lagging-Safety-Indicators-to-Manage-Workplace-Health-and-Safety-Risk_V7-LR1.pdf)
- Wachter, J. (2012, April). Trailing safety indicators: Enhancing their value through statistics. *Professional Safety*, 57(4), 48-53.

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.