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Leading indicators of construction safety performance

Jimmie Hinze [a,*], Samuel Thurman [b], Andrew Wehle [a]

[a] M.E. Rinker, Sr. School of Building Construction, University of Florida, 340 Rinker Hall, P.O. Box 115703, Gainesville, FL 32611-5703, USA
[b] Fluor Corporation, 141 Shore Front Ln, Wilsonville, AL 35186-8610, USA

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ABSTRACT

The concept of using leading indicators of safety performance is introduced with a clear contrast given with lagging indicators. Leading indicators of safety performance are measures of the safety process as it applies to construction work, while lagging indicators pertain to the safety results, namely the extent of the occurrence of worker injuries. Leading indicators consist of both passive as well as active measures. Passive measures are those which can be predictive over an extended period of time while active measures are those which can initiate corrective steps in a short period of time. Suggestions are offered on the selection and use of effective leading indicators. The results of a simple research study demonstrate the extent to which leading indicators can be utilized to distinguish the differences in project safety performances.

1. Introduction

Traditionally, safety performance has been measured by such metrics as the Occupational Safety and Health Administration (OSHA) recordable injury rate (RIR); days away, restricted work, or transfer (DART) injury rate; or the experience modification rating (EMR) on workers' compensation. These have served the purpose of providing information by which contractors could assess their safety performance in terms of construction industry averages on those metrics or to make comparisons with other firms. These have also been used widely by OSHA, insurance companies, facility owners, and other parties involved in the construction industry. When these measures were examined over a period of years, trends could be identified. For example, OSHA recordable injury rates and DART injury rates have been examined extensively to show that safety performance in the construction industry has improved significantly over the past decades (see Fig. 1). Other metrics that have been used, although much less extensively, include loss ratios (ratio of the cost of claims to the cost of premiums), the number of liability claims associated with worksite injuries, and the number of OSHA citations/fines.

The statistics presented in Fig. 1 show that the safety performance of the construction industry has improved significantly over the period of time covered. Unfortunately, the data do not give any insight as to the factors that contributed to these improvements. For example, OSHA made significant regulatory changes in the areas of trenching safety, fall prevention, and steel erection. OSHA also became more aggressive in its enforcement of the OSHA regulations in selected sectors of the construction industry. Perhaps these contributed the safety performance improvements. Because of the escalating costs of health care and workers' compensation, contractors may also have increased their efforts to improve their safety performances or to more aggressively manage their injury claims. The data shown in Fig. 1 are known as lagging indicators in that they depict the past safety performance of the construction industry, but they give no information on "why" these changes occurred.

A closer examination of the data shown in Fig. 1 reveals that there were fluctuations from year to year, but there were more dramatic improvements from 1989 to 1998 than from 1998 to 2009. That is, the rate in safety improvements declined considerably in the last half of the period represented. It should be evident that these measures of safety performance will decline at a lower rate as these measures reach a point of diminishing returns. Other measures may be more appropriate to monitor safety performance.

Various measures of safety performance have been used for decades and they have served a useful purpose. They will continue to be used, but their use as a means of predicting the level of safety performance in a construction firm or on a particular construction project has serious shortcomings, i.e., different metrics are required to predict future safety performance. This is where leading indicators of safety performance can be very useful.

2. Leading versus lagging indicators

Safety performance has traditionally been measured by metrics such as OSHA recordable injury rates, DART injury rates, and EMR that are gathered after losses have been incurred and cost assessments have been made (Grabowski et al., 2007, 406). The tradi-

* Corresponding author. Tel.: +1 352 273 1167; fax: +1 352 392 9606.
E-mail address: hinze@ufl.edu (J. Hinze).

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tional metrics noted provide historical information about some aspect of the measures of safety performance that has occurred. These measures are known and classified as lagging indicators. Jack Toellner describes lagging indicators as measurements that are linked to the outcome of an accident (Toellner, 2001, 42).

While lagging measurements can provide data about incidents after the fact, the question remains regarding the value of these metrics as future predictors for safety in the workplace. Grabowski notes that a growing number of safety professionals question the value of lagging indicators and argue that lagging indicators do not provide enough information or insight to effectively avoid future accidents (Grabowski et al., 2007, 406). Mengolini and Debarberis support this position stating that past performance is a poor predictor of future results. Additionally, an unbalanced focus on lagging after-the-fact based measures may convey an unintended message that safety prevention is less important (Mengolinim and Debarberis, 2008, 245).

In contrast, leading indicators are measures which are not necessarily historical in nature but rather can be used as predictors of future levels of safety performance. In the literature, Toellner characterizes leading indicators as measurements linked to actions taken to prevent accidents (Toellner, 2001, 42). Grabowski describes leading indicators as conditions, events, or measures that precede an incident and has a predictive value in regards to an accident/incident/unsafe conditions (Grabowski et al., 2007, 406). Manuele (2009, 32) was critical of the use of leading indicators and advocated that "practitioners should focus on hazard identification and analyzing the risks associated with those hazards..."

For the purposes of this discussion, the authors characterize leading indicators of safety performance as consisting of a set of selected measures that describe the level of effectiveness of the safety process. Leading indicators measure the building blocks of the safety culture of a project or company. When one or more of these measures suggest that some aspect of the safety process is weak or weakening, interventions can be implemented to improve the safety process and, thereby positively impact the safety process before any negative occurrences (injuries) are sustained.

A comparison of the leading and lagging indicators will give a general sense of the terminology that has been used to show or demonstrate their differences. The following terms are associated with these indicators:

Leading indicators	Lagging indicators
Upstream indicators	Downstream indicators
Predictive indicators	Historical indicators
Heading indicators	Trailing indicators
Positive indicators	Negative indicators

Regardless of the terminology, there are certain traits or characteristics that separate leading from lagging indicators. One key difference in leading versus lagging indicators lies in the type of response that is elicited by them when the measures indicate that performance is not as desired. With leading indicators, the response is proactive in nature, and the intent is the make changes in the safety process so that injuries do not occur. With lagging indicators, the response is reactive in nature as a response is made after injuries have already occurred and the response is initiated to try to prevent the occurrence of further injuries. Thus, with lagging indicators a response is generated only after workers have already sustained injuries and have endured some level of suffering.

The fundamental difference between leading and lagging indicators are readily apparent. Since lagging indicators might prompt a response after an injury or a series of injuries have occurred, it should be evident that lagging indicators of safety performance

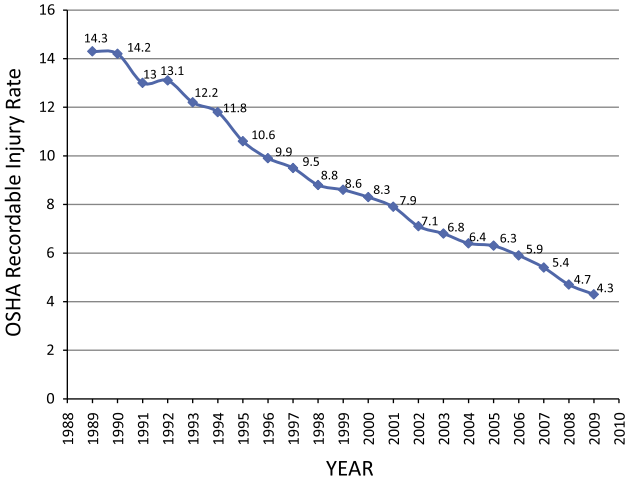

Fig. 1. Construction industry injury rates 1989–2009.

are based on past safety performance results. Reactions to lagging indicators are generally viewed as being negative in nature. That is, a response is not typically generated to lagging indicators of safety performance unless the trend shows that safety performance is below expectations. Also, since the lagging indicators do not give information on "why" the level of safety performance is below expectations, the reaction or response tends to be a wholesale or "shotgun" approach of action items that are intended to address a multitude of possible weaknesses in the system. Additionally, Toellner states that trailing indicators have an inherently low level of confidence due to the high number of unaccountable variables such as the people influencing the decision to record an accident as well as the negative connotations often associated with reporting an incident (Toellner, 2001, 42).

This is where leading indicators are decidedly different, i.e., leading indicators are designed to essentially monitor construction safety processes and when the measures show that there is a flaw in the process some type of intervention is initiated. That is, leading indicators provide a means of tracking or monitoring the performance of a process as it is taking place or they provide way of showing whether a particular process or processes are being implemented as planned. If flaws are noted in the process implementation, there is an increased possibility of injury occurrence. An intervention is then initiated to make corrections in the process. Various aspects of leading indicators will be examined.

3. Passive versus active leading indicators

Leading indicators of safety performance can be classified as being passive or active. Passive leading indicators are those that provide an indication of the probable safety performance to be realized within a firm or on a project. While they may be somewhat predictive on a macro scale, they are less effective as being predictive on a short-term basis. That is, the process being monitored by passive leading indicators cannot generally be altered in a short period of time. Examples of passive leading indicators include the following:

- Number or percent of management personnel with 10-h (or 30-h) OSHA certification cards.
- Number or percent of field employees with 10-h (or 30-h) OSHA certification cards.
- Number or percent of subcontractors selected, in part, on the basis of satisfying specific safety criterion prior to being awarded the subcontract.