



Exploring the state of health and safety management system performance measurement in mining organizations



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ARTICLE INFO

Article history:

Received 22 May 2015

Received in revised form 17 August 2015

Accepted 7 November 2015

Keywords:

Health and safety management system

Lagging indicators

Leading indicators

Mining

Performance measurement

Multiple method measurement

ABSTRACT

Complex arguments continue to be articulated regarding the theoretical foundation of health and safety management system (HSMS) performance measurement. The culmination of these efforts has begun to enhance a collective understanding. Despite this enhanced theoretical understanding, however, there are still continuing debates and little consensus. The goal of the current research effort was to empirically explore common methods to HSMS performance measurement in mining organizations. The purpose was to determine if value and insight could be added into the ongoing approaches of the best ways to engage in health and safety performance measurement. Nine site-level health and safety management professionals were provided with 133 practices corresponding to 20 HSMS elements, each fitting into the plan, do, check, act phases common to most HSMS. Participants were asked to supply detailed information as to how they (1) assess the performance of each practice in their organization, or (2) would assess each practice if it were an identified strategic imperative. Qualitative content analysis indicated that the approximately 1200 responses provided could be described and categorized into *interventions*, *organizational performance*, and *worker performance*. A discussion of how these categories relate to existing indicator frameworks is provided. The analysis also revealed divergence in two important measurement issues; (1) quantitative vs qualitative measurement and reporting; and (2) the primary use of objective or subjective metrics. In lieu of these findings we ultimately recommend a balanced measurement and reporting approach within the three metric categories and conclude with suggestions for future research.

Published by Elsevier Ltd.

1. Introduction

Health and safety management systems (HSMS) are broadly characterized as a set of institutionalized, interrelated, and interacting elements strategically designed to establish and achieve occupational health and safety (H&S) goals and objectives (ANSI/AIHA Z10, 2012). The goals and objectives of HSMS activities center on occupational injury, illness, and loss prevention. Numerous consensus standards provide guidance across industrial sectors as to the types of activities important for inclusion in an organization's HSMS (e.g., ANSI/AIHA Z10-2012; British Standards Institute, 2007; U.S. National Mining Association's [NMA] CORESafety). Although HSMS frameworks offer varying types and numbers of elements, each system is grounded in the now institutionalized Deming/Shewhart plan-do-check-act cycle (Haight et al., 2014). In addition, they each include activities designed to develop an organization's internal infrastructure in order to enhance the

effectiveness of the activities within the cycle (e.g., employee involvement, leadership, organization and allocation of resources, etc.).

HSMS performance measurement and monitoring activities are used to determine whether the system is functioning as designed and to help evaluate the system's overall effectiveness (ANSI/AIHA Z-10, 2012). Performance indicators are the fundamental building blocks to the measurement and monitoring process of an HSMS. The information provided via performance indicators can be used to facilitate strategic H&S management decision-making and the implementation of appropriate risk management actions on behalf of the organization. However, theorists and researchers continue to debate the theoretical and practical perspectives of occupational HSMS performance measurement. This issue was recognized as early as when Petersen (2001) stated "Measuring the effectiveness of an organization's safety system has been a particularly difficult problem for all organizations" (p. 54). Indications that HSMS performance measurement remains a current concern can be gleaned from more recent publications. For example, Juglaret and colleagues (2011) argued that, although HSMS is an established tool to manage

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occupational safety and health, how to effectively measure the performance and control of these systems remains a question in the literature. In response to the lack of empirical guidance regarding HSMS performance measurement, health and safety managers were asked how they commonly measure HSMS effectiveness via a variety of practices. This paper reports on common performance measures utilized by a sample of health and safety managers of mining organizations and, based on the data, proposes a new HSMS performance measurement framework that can be used to assess the performance of occupational health and safety initiatives.

2. Literature review

To date, there appears to be little consensus among researchers and practitioners in regard to the terms used to categorize the types of performance indicators used to assess the effectiveness of HSMS elements and practices (e.g. Körvers and Sonnemans, 2008; Laitinen et al., 2013; Reiman and Pietikäinen, 2012). Several indicator frameworks exist in the literature however, and most adhere to the leading/lagging indicator typology.

2.1. A brief review of performance indicator categorizing frameworks

Several indicator frameworks are similar in practice but utilize different terms to describe their areas of focus. For instance, Körvers and Sonnemans (2008) and Laitinen et al. (2013) synonymously refer to *proactive/reactive* indicator types. They argue that *proactive* indicators can be subcategorized as either *predictive* or *monitoring*. *Predictive proactive* indicators supply information on the types of managerial actions that have been taken to reduce workplace risk. *Monitoring proactive* indicators include H&S related outcomes observed prior to the occurrence of a major incident such as small releases of hazardous substances or near misses, the results of safety inspections and behavioral observations, the results of safety audits, and safety attitudes. In a similar argument, Laitinen et al. (2013) suggest that the *proactive activity* indicators capture the managerial activities being done in organizations (e.g., number of audits completed; number of workers trained). They describe *proactive activity* metrics as indications of what activities are being done in the organization rather than information about the results of those activities. In contrast, *proactive outcome* indicators, such as personnel knowledge, focus on results and observable outcomes rather than mere activities.

Similarly, Reiman and Pietikäinen (2012) suggest that performance indicators could be categorized as *lag outcome*, *lead monitor* indicators, and *lead drive* indicators. They indicate *lag outcomes* do not merely capture harm associated with traditional *lagging* indicators but capture information related to the temporary end result(s) of a continuous process. *Lead drive* indicators reflect the workplace activities aimed at improving safety and include, for example, measures of supervisory activity and practices related to physical hazard control. They are “measures of the fulfillment of the selected safety management activities” (p. 1995). *Lead monitor* indicators measure the potential of the organization to achieve safety and include measures related to worker safety motivation, awareness, and knowledge.

As is evident from the brief review, despite varying terminologies, most theoretical categories integrate the leading/lagging indicator typology. This framework is most prevalent in mining as well (Industrial Council on Mining & Metals, 2012). Therefore, we focus on the nuances of this framework in the subsequent sections as well as potential drawbacks of applying such measures in a mining environment.

2.2. Limitations of current indicator frameworks

The terms *leading* and *lagging* originated within the economics discipline as a way to describe key indicators of economics and business cycle performance over time-dependent phases (Diebold and Rudebusch, 1994; Shishkin, 1961). Perhaps because of the introduction and widespread acceptance of HSMS and its cyclic similarity to economic and business cycles, the *leading/lagging* and related terms (e.g., *proactive/reactive*; *leading/trailing*; *upstream/downstream*) were adopted to help identify and describe the types of indicators important to assess the effectiveness of HSMS performance.

Given the appeal and seeming utility of the *leading/lagging* indicator categories, numerous efforts have been undertaken to develop the theory and application underpinning the framework. Strictly based on their definitions, *lagging* indicators represent information related to significant safety incidents such as injuries, illnesses, and major property losses, while *leading* indicators can conceptually span the plan, do, and proactive checking phases of the management system cycle. The purpose of *leading* indicators is to understand and manage the organizational circumstances thought to precede undesired occupational H&S outcomes (International Council on Mining and Metals, 2012). With the exception of Körvers and Sonneman’s (2008) discussion related to *predictive proactive* indicators, however, most work on *leading indicators* seems to neglect management practices related to the risk management planning phase of the system cycle. This suggests that indicator frameworks grounded in the leading/lagging nuance may not be optimally positioned to assess the actual effectiveness of the full breadth of HSMS activities that take place before and after the occurrence of occupational injuries (i.e., practices involved with preventing and investigating safety incidents and implementing corrective actions) or management review activities.

Additional limitations of the leading/lagging terms have been articulated (e.g., Janicak, 2011; Juglaret et al., 2011; International Council on Mining and Minerals, 2012; Wachter, 2012; Reiman and Pietikäinen, 2012; O’Neill et al., 2013; Payne et al., 2009; Hale, 2009; Hopkins, 2009). First, an imprecise link between the two terms has been noted. One of the more practically beneficial features of the *leading/lagging* framework centers on the premise that assessing and managing well-chosen *leading* indicators minimizes the potential for poor performance as assessed through *lagging* indicators. The most effective *leading* indicators within an organization can then be determined through rank order of the magnitude of the correlations (presumably negative) linking the list of *leading* indicators to the identified *lagging* indicators. Although attractive theoretically, in practice there are complex causal pathways between *leading* and *lagging* indicators as well as time-lagged linkages (Janicak, 2011; International Council on Mining and Minerals, 2012; Wachter, 2012; O’Neill et al., 2013).

This complex causal pathway argument is consistent with the idea of statistical moderation—i.e., the relationship between two variables is contingent upon the level of a third, perhaps unidentified, variable. Because the possible moderating contingencies within an organizational context are numerous, this argument suggests that it may be difficult to make strategic decisions regarding HSMS activities merely based on the correlation between the *leading* and *lagging* indicators chosen—especially in the case of a null or small correlation between them. Relatedly, in some cases, the effect of *leading* on *lagging* indicators may take time to actualize; some have suggested years perhaps (Wachter, 2012). This, again, increases the difficulty and imprecision of strategic management decision-making through the use of *leading/lagging* indicator correlations (i.e., how long should a *leading* indicator with no observable effect be tracked and managed before new indicators are chosen and the stopwatch starts again?). These issues may be one reason

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