



From reactive to proactive – Can LPIs deliver?

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1. Introduction

In his article ‘Thinking about Process Indicators’ Andrew Hopkins has questioned our understanding of what constitute leading and lagging indicators of safety. He has drawn attention to the highly-regarded and influential Baker report into the Texas City Disaster of 2005 and to the UK Health and Safety Executive’s guidance on leading and lagging performance indicators in order to develop his arguments. From my reading of his article, I understand that the distinction between personal and process measures of safety are well-understood and well-documented. The issue in question is how to define a leading rather than a lagging indicator of safety and it is here that confusion appears to reign. In addressing the issues raised by Hopkins in his article, I will turn to my experiences with the UK oil and gas industry and in particular, to my involvement in producing guidance documentation for the industry focusing on leading performance indicators for safety (LPIs), in order to try and clarify some of the issues raised.

2. Disentangling the confusion of LPIs?

In 2000 I was part of a working group, which put together guidance on Leading Performance Indicators for Health and Safety in the UK Oil and Gas Industry (*Step-Change in Safety, 2001*). In this document, a leading performance indicator is defined as ‘*something that provides information that helps the user respond to changing circumstances and take actions to achieve desired outcomes or avoid unwanted outcomes*’ (op.cit. p. 6). Lagging indicators are described as the outcomes that result from our actions. We used the analogy of sailing a yacht as an example. In our yacht, the compass, wind indicator and radar provide information that can be used to control the boat to maximise speed in the direction that we want to go, whilst avoiding danger. These are leading indicators, which provide information about the current situation that can affect future performance. The log provides a measure of how far we have travelled (an outcome of our actions, i.e. a lagging indicator). We stressed the importance of the monitoring, feedback and control processes that are essential for effective use of LPIs, i.e. the ‘plan, do, check, adjust (PDCA)’ cycle of continuous improvement. For example, in our yacht, the radar in itself will not prevent us going aground. Appropriate action must be taken to avoid disaster. Many of the organizations I work with collect plenty of leading and lagging performance indicators of safety. However, they do not seem to have either the desire or the resources to analyse these data effectively

and actually do something with the results. The same could be said for BP at Texas City. They had collected all the safety intelligence that would have indicated that something was amiss on the plant, but they had chosen to ignore it or do nothing with it – presumably because the organization had other priorities.

So why the confusion between leading and lagging indicators? In my opinion, this confusion only arises because organizations fail to take cognisance of data that *indicates* there may be something wrong with the system. By not investigating perturbations in plant activities, they fail to establish possible relationships between the warning events and potential adverse outcomes. As Weick (2001) would say, the organizations lack the ‘prerequisite imagination’ and fail to ‘make sense’ of what is happening. It is the ‘heedful mindfulness’ and appropriate responses to indicators that are important, but this requires application and effort and organizational resources are limited. I tried for a number of years to persuade offshore oil and gas companies to benchmark their leading indicators of safety as well as their lagging indicators. My rationale was that through this process they would learn what leading indicators are important and how these indicators influence adverse outcomes. Needless to say, I was unsuccessful in my attempts although many organizations continue to benchmark their lagging indicators of safety (e.g. Sheiiba, see www.sheiiba.com/index.asp).

3. What do leading and lagging indicators actually show us?

According to the OECD (1993) indicators can come from several parameters and give information about a phenomenon in the form of a value. It should be noted that indicators do not necessarily represent reality, but are an attempt to reflect the truth in the form of multiple and different forms of data. In other words they are just indicators. I think this is an important point that has been overlooked in both Hopkins’s article and in the reports that he makes reference to. There seems to be an implicit assumption that LPIs are a ‘bonafide pipeline’ to lagging indicators, whether those be personal injuries or process incidents. However, safety performance is a complex phenomenon operating at many different levels (i.e. individual, group, organizational) and therefore cause and effect relationships are very difficult to establish and verify. For me this is a critical issue. If an indicator is ‘leading’ in the true sense of the word, then that indicator should demonstrate a valid and reliable relationship with a ‘lagging indicator’ further down the line. Because accidents by their nature are due to a particular set of sometimes complex circumstances coming together at a particular point in time, simple one-to-one relationships between

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leading and lagging indicators are not easy to delineate and therefore the predictive validity of LPIs is difficult to establish. In addition, there is evidence that process-type incidents are 'predicted' by a different set of LPIs than personal injuries (for example, see Mearns et al., 2003).

We have conceived of safety climate as a 'leading' indicator of safety performance in terms of accidents/personal injuries (Flin, 1998; Flin et al., 2000) and recent meta-analyses have shown 'moderate' relationships between safety climate and accidents/injuries and unsafe behaviour (e.g. Clarke, 2006; Nahrgang et al., 2006). Despite these relatively convincing results, it is worth noting that the aforementioned meta-analyses were largely based on cross-sectional data and experimental and longitudinal studies would provide stronger evidence of a relationship. For example, in an experimental intervention study (Zohar, 2000) found a relationship between safety climate at the group level (work teams in the manufacturing sector) and micro-accidents (defined as 'behaviour-dependent on-the-job minor injuries requiring medical attention'). In a longitudinal study in the transport sector, Wallace et al. (2006) found a relationship between foundation climate (organizational support); good employer/employee relationships and safety climate (measured at time one) and road accidents (measured a year later). Thus it would appear that evidence is accumulating to suggest that safety climate is a 'leading indicator' of safety performance, certainly in terms of personal injuries. The focus is now on understanding the antecedents of positive safety climates but more work is required to establish what the leading indicators are for process events.

In conclusion, perhaps we should move away from the concept of leading and lagging indicators and focus instead on Key Performance Indicators for safety (KPIs). These KPIs should be based on empirical evidence, i.e. that reliable relationships are found between the measurement of a leading indicator, e.g. safety climate and outcome measure such as lost-time injury rates or some other hypothesised relationship between a particular set of input measures and an outcome measure. New concepts such as 'resilience'

(Hollnagel et al., 2006) are being developed to replace old ideas about reactive responses to safety failings. The 'resilience' movement focuses on how people in high reliability organizations successfully deal with complexity and are attentive to minor fluctuations that could signal potential failure, i.e. by taking a proactive approach. Resilient organizations put mechanisms in place to recognise, anticipate and defend against failure and it may be that the high reliability organizations of the future will focus even more on LPIs in an attempt to build resilience and prevent incidents from occurring. The challenge now is to find out what those key indicators are through high quality, systematic research.

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