Lonmin’s innovative approach to safety: ’safety focus on leading indicators’

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Lonmin Mining’s safety journey has reached a lost time injury frequency of 0.71, which represents an 80.4% improvement during the past five years. At current performance levels, making use of lagging indicators will not drive further safety improvements. An EXCO decision has been taken to adopt a more daring approach, and focus on leading indicators and predictive analysis in our journey towards zero harm.

The ICMM Leading Indicator Guideline defines and re-iterates: ‘With the well-being of people in the mining industry an overriding priority, prevention of harm is a core driver of management approaches to OHS’. The closer an organization gets to ‘zero harm, as measured using lagging indicators, the more difficult it is to ensure safety through tracking lagging performance, and to determine whether it is luck or design that is keeping numbers low (Step Change in Safety, n.d.); confidence intervals are infinitely wide for rare events, including catastrophic accidents (i.e. low-probability, high-consequence events) (Grabowski 2006). It is therefore unreliable to make any generalized causal inference from too few data points (Hopkins 2007). Management efforts should preferably be focused on more frequently measurable leading indicators of precursor circumstances. Moreover, lagging indicators have lost their ability to motivate or influence measurable safety performance improvement (Broadbent and Arnold, 2011c). For a leading indicator to contribute to achieving zero harm there needs to be a reliable and valid cause and effect relationship established between the leading indicator and OHS performance (Janicak, 2003). The further away from the undesired outcome (such as a safety incident) a leading indicator is identified up the causal pathway, the better the chance of addressing the shortcomings that might result in the incident, but the more difficult it is to identify causality (CCPS, 2008). This is because OHS outcomes can result from an accumulation of multiple causes.’

To successfully adopt leading indicators across Lonmin’s mining operations a change management process needed to be carefully considered, which included design criteria and business information management flow optimization, which would support the safety strategy. It is vital that the implementation of leading indicators is not experienced by mining leaders and managers as an ad hoc and add-on ‘flavour-of-the-month’ initiative, but is truly integrated and supports the mining teams’ values and behaviours.

To continue with sustained improvement, the implementation of leading indicators in all the mining operations has proven to be a positive step in the right direction. It is clear that this bold initiative is similar to sailing in uncharted waters and there are many perils and pitfalls along the journey. Yet, it provides the opportunity for the discovery of key learnings.
leadership corps within context is of the utmost importance. The link to the business risk has to be calibrated and correlated to perception surveys and culture surveys. Figure 2.

Lagging or outcomes indicators have been used for some time in the mining industry to track when damage, injury, or harm has occurred, in an attempt to introduce measures that will prevent future harm. Leading or activities indicators measure the direct and indirect precursors to harm, and give advance warning of an event that might lead to an undesired outcome, providing an opportunity for preventative action to be taken.

The value proposition for the use of leading indicators is that of prevention of loss or damage, whether to people, the environment, or property. To be effective, leading indicators must be integrated with the overall business objectives, strategy and decision-making processes to deliver on desired performance. The closer an organization gets to ‘zero harm’, as measured using lagging indicators, the more difficult it is to ensure safety through tracking lagging performance, and to determine the factors that contribute to improved performance. Any generalized causal inferences based on these rare events are also unreliable. Management efforts should therefore be focused on more frequently measurable leading indicators of precursor circumstances. It is reported that lagging indicators have also lost their ability to motivate or influence measurable improvements in safety performance.

- Employee understands that safety is as important as production and has accepted responsibility for all aspects of safety performance
- Employee has established (maintains) appropriate safety goals for the section / unit and implemented plans to meet these goals
- Employee has communicated to those who report to him the company’s safety standards and goals.
- Sufficient training to know how to achieve expectations
- A determination of whether or not the expectations have been achieved
- A reward (based upon the performance sufficiently large to gain attention and maintain interest.

**Background**

The ICMM Leading Indicator Guideline (ICMM, 2012) explains that:

‘The use of leading indicators contributes directly and indirectly to the mining value case. The precursors of undesired OHS outcomes lie in areas relating to people (including behaviour and degree of ownership), organizations (including culture), systems (across all business areas), processes (especially technical, but also administrative), physical plant and processing (technical and technological). The business case for the use of leading indicators is loss prevention across all of these areas. Lagging indicators can only measure performance after the potential for harm, loss or damage has manifest. Leading indicators can assist in anticipating outcomes in which damage or harm may be a consequence by identifying...”
weaknesses in OHS management, thus creating the opportunity to implement proactive measures to reduce the risk of the harm occurring. Leading indicators require an organization to change its mindset (Broadbent and Arnold 2011), from one of exclusively event tracking and external benchmarking, to one of value preservation, risk avoidance and sharing of measures shown to improve performance (Goldcorp 2011). Leading indicators are an important tool for risk avoidance.

Leadership
The ICMM Leading Indicator Guideline research shows that:

'Some organizations believe that leadership, culture and beliefs about safety may be the most important factors in determining organizational safety performance. Other organizations believe that it is more valuable to focus on failures closer to the incident, by monitoring the implementation of critical control integrity linked to material risks. Irrespective, it is widely recognized that in the absence of sound leadership, other measures to manage OHS often fail. The use of leading indicators relating to appropriate measures of leadership (as opposed to the more commonly recognized “behaviour-based safety” measures) is an area of increasing research and focus'.

As organizations mature the safety goals need also to mature and migrate away from lagging to leading indicators. The measurement of safety requirements drives the process, but it is extremely important that the quality requirements be established and assist to drive the discussion and collaboration processes. Firesmith (2003) has presented an information model for safety engineering that depicts a holistic view. Safety risk should always be at the centre of attention. The reduction of accident frequency is poor measure of safety indicator success. Figure 5.

A well-defined business process needs to be established to drive leading indicators. It has to be a focus area and dealt with at the sustainability board level. To initiate the way forward a “looking down and into the organization” process is required. Figure 6.

Stakeholders’ leading indicators and management systems
Unlike lagging indicators, leading indicators evolve throughout the life of an organization, depending on a number of factors, not least of which is the organization’s
Figure 5. Information model for safety engineering (Firesmith, 2003)

Figure 6. Lonmin safety operational model
level of maturity. Three levels of leading indicators—compliance, improvement, and learning—have been linked to five levels of organizational maturity. The intention in so doing is not to create expectations of ‘advancing upwards’ towards higher maturity levels. Rather, it has been shown that if an organization attempts to implement a higher-level leading indicator and is not at the appropriate level of maturity, these measures can be unsuccessful. For the purposes of this overview, an organization that has a mature OHS culture is one in which leadership is demonstrated at all levels of the organization, through a caring culture that is explicit in all activities, communication, interactions, tasks, and measures of OHS success.

This ongoing evolution therefore means there is no single set of leading indicators that can be used in perpetuity within an organization. Similarly, leading indicators appropriate for use in one organization may not be transferable to or comparable with other organizations. As the maturity of the organization evolves, the intention is not that the ‘lower level’ maturity leading indicators are discarded. Appropriate compliance and improvement leading indicators must be retained to ensure that basic preventative management measures are delivering the expected outcomes. Leading indicators should be linked to the highest priority OHS risks affecting an organization. As per the traditional risk-control hierarchy, leading indicators that can identify measures relating to the elimination or avoidance of risk have the greatest potential to deliver the desired OHS outcomes. Figure 7.

The implementation process

The ICMM has identified a 15-step iterative process to assist organizations in implementing leading indicators. Leading indicators are most effective when they are identified and used across all levels and functional areas of the organization. This provides multiple partial views of the organization that together give a more complete picture of management efforts than any single measure might.

Leading indicators are of most use when they are developed, applied, and used by the people responsible for implementing the appropriate preventative action. The process of developing leading indicators should, nonetheless, be informed by multidisciplinary viewpoints and by representatives from all levels of the organization, because of the complexity of the causal pathways.

Adoption needs to consider perceived attributes of innovation, type of innovative decision, communication channels, and nature of systems as well as change agent promotional efforts. Figure 8.

Data and reporting

The ICMM Leading Indicator Guideline recommends that ‘leading indicators can be presented as qualitative and quantitative data, and should ideally demonstrate trends, rather than instantaneous measures of performance. This approach does not correlate well with current OHS reporting practices, which may need to evolve to accommodate leading indicator reporting’. In support of the adoption process of a leading indicators programme, the functional and non-functional requirements that relate to data, quality and interface need to be methodically articulated. This is not always possible, but the best available resources need to be collated. The implementation, design, and architectural constants need to be established and discussed at length. Figure 9.

The Lonmin leading indicator matrix is relevant to the Group’s maturity journey, which can best be described as ‘involved’. In this phase the key actions are legally compliant leadership, ISO accreditation, and business rules fully implemented. The resultant outcome is ‘walk-the-talk’ and show commitment in VFL self-governance in preemptive compliance / legislation, and zero harm maintained. The mining safety journey needs to progress to the next phase, which is termed commitment, then finally attain a ‘passion’ phase. Figure 10.
Variables determining the rate of adoption

I. Perceived attributes of innovations
   1. Relative advantage
   2. Compatibility
   3. Complexity
   4. Trialability
   5. Observability

II. Type of innovative-decision
    1. Optional
    2. Collective
    3. Authority

III. Communication channels (e.g., mass, media or interpersonal)

IV. Nature of the social system (e.g., its norms, degree of network interconnectedness, etc.)

V. Extent of change agents’ promotion efforts

Figure 8. Adoption risk areas

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Figure 9. Requirements information model (Firesmith, 2003)
Leading indicators results are consolidated over total performance and should not be seen as an additional measure.

**Complex causal pathways**

OHS outcomes can result from an accumulation of multiple causes; for a leading indicator to contribute to improved OHS performance there must be a demonstrable cause-and-effect relationship established between the leading indicator and OHS performance. Leading indicators can point to root causes of OHS outcomes. Precursors of undesired OHS outcomes lie in areas relating to:

- People (including leadership, behaviour, and degree of ownership)
- Organizations (including culture)
- Systems (across all business areas)
- Processes (especially technical, but also administrative)
- Physical plant and processing (technical and technological).

![Figure 11. Employee interactions actions](Step Change in Safety, 2002)
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Jacques Erasmus, is the Head of Safety at Lonmin platinum. He joined Lonmin on July 2008 as the Senior Manager (SHREQ). He was recently appointed to the Mine Health & Safety Council (MHSC) by the Minister of Mineral Resources, and this appointment recognises the achievement of every employee on the journey for Zero Harm. The main task of the Council is to advise the Minister on Occupational Health and Safety Legislation and Research outcomes aimed at improving and promoting occupational H&S in South African mines. In September 2002, he joined Department of Mineral & Energy as the Principal Inspector of Mines, in 2006 he was appointed as the Deputy Chief Inspector of Mines. During the latter part of 2006 he acted extensively as Chief Inspector reporting to the Director General and Minister. Then in February 2007 he joined AngloGold Ashanti and was appointed as the Regional Safety Manager for Africa Operations. During the beginning of 2008 he was appointed to the Board of JIC Mining in his capacity as Director (Technical Services).

He affiliates with AMMSA (Association of Mine Managers of South Africa) and AMPSA (Association of Mine Safety Professionals of South Africa). Jacques has 35 years of experience in leading senior mining positions and holds a Master’s Degree in Engineering. Jacques is vision lead, values driven and goal orientated. He embraces diversity, he is on a mission to achieve Zero Harm, being fatal free.