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Using Key Risk Indicators (KRIs) to Navigate Performance Metrics

E. Hunter Harrison was a formidable railroad executive: Railroader of the Year for three railroads in 2002 and again in 2015, and CEO of the Year from the *Globe and Mail*. His triumph: Introducing precision scheduled railroading to revolutionize railroads' century-old processes in the companies that he ran - Illinois Central, Canadian National (where I worked for the SVP Operations), Canadian Pacific, and CSX.

Railroads are notoriously siloed - operationally & geographically.[1]

EHH[2] changed all that. He would ask transportation for the terminal dwell times, the diesel shop for locomotive availability, and the car shop for time to complete pre-departure train inspections, quickly identify bottlenecks by cross-referencing these metrics, and require previously siloed operational groups to collaborate and fix these. During his nine years at CN, profit margins rose from ~0% to 40% and the share price soared by 390%. EHH demonstrated that one of the best methods for creating value and integrating operational risks is by using performance metrics.

What gets measured gets managed. As a result, we have seen a (confusingly large) explosion of key performance indicators (KPIs). More are continually added with none removed. Yet, if everything is a priority, nothing is. And management efforts become scattered. Management control systems and performance metrics are typically the purview of management accounting and finance types.[3,4,5] Yet, for high hazard industries especially, operations and risk management experts have uniquely valuable insights in how to align, measure, manage, and reward performance. In this 'think piece', I outline: What are key risk indicators? How to best use them? And how can we declutter these? Most simply, we create KPIs to measure how our companies are doing as ***input, process***, or ***output*** variables. They are typically aligned with strategic goals to operationalize these into business functions (see Table 1).

BUSINESS FUNCTION	INPUT	PROCESS	OUTPUT	STRATEGIC GOAL
Marketing/sales	Leads identified	Clients secured	Referrals given	Increased sales revenue generated
Research / Innovation	Research dollars invested	Field tests ongoing	Patents filed	Increased % revenue from new products
Maintenance	Time between inspections	Mean time to repair	Unplanned downtime	Reduced maintenance costs

Table 1: Sample of business functions' input, process, and output KPIs as related to strategic goals.

What are lagging versus leading indicators?

Lagging indicators measure past performance, while leading indicators (ideally) predict future outcomes to direct attention and resources to manage that performance. As KPIs are reported on annual reports, these are typically lagging indicators;[6] with leading indicators used less frequently.[7] Yet, if we embed leading indicators in our project and process management, managers are better equipped to align their daily decisions with companies' strategic objectives.

THE BEST LEADING, KEY PERFORMANCE INDICATORS ARE THOSE THAT:

- Are valid, useful, and predictive to achieve your company's priorities
- Drive improvements and/or anticipate, prevent, or eliminate risks and losses
- Make good use of data already collected
- Positively monitor and evaluate achievable performance of what people do (behavioural based), not what they fail to do
- Offer timely, relevant, and frequent feedback to all levels of management and workers
- Are sensitive enough to show even small improvements in performance
- Motivate changed behaviour, personal commitment, and continuous improvement

This list of best KPIs might seem simplistically obvious. Yet, I have no doubt that you could review the performance measures for a shift, function/department, or business unit and identify some that do not meet these criteria.

In the best case, a business unit's 1) input variables are the leading predictors for their own lagging process and output variables, 2) they understand the relationships between variables, 3) managers can measure and control all these variables, and 4) they're rewarded and motivated to do so. In the worst case, a business unit has too many or no performance indicators, they don't understand the relationship between leading and lagging indicators, they cannot control these, or these create perverse incentives that undermine corporate performance. For example, a frontline supervisor is responsible for the Lost Time Injury Rate (LTIR) or Total Recordable Injury Rate (TRIR) of his machine operators (output variable, which his bonus is based upon), yet his operators are incompetent for the task at hand (process variable, probably not measured), because their turnover rate is 85% (input variable to safety, maybe measured by HR, but controlled by subcontractors and supply management's perverse 'lowest cost provider' requirement). As a result, frontline supervisors will probably suppress reporting of incidents (perverse incentive) and have higher burn-out and turnover rates amongst their own ranks, leading to uneven production and profitability.

What are key risk indicators (KRIs)?

Like KPIs, Key Risk Indicators (KRIs) equip your company to proactively identify and manage threats to your objectives.[8] High hazard industries have developed sophisticated operational risk management systems to manage company-killer-level risks. The relative frequency of these leading indicators for workplace injuries/fatalities is often depicted as a pyramid (see inset pyramid in Fig. 1). Process safety and operational risk management extends the apex with more significant consequences and the base with additional measures of unsafe acts and latent systemic factors. The logic is that catastrophic events occur if you have loss of control/containment, failures in your barriers/controls unsafe acts and conditions, and weaknesses in your risk management systems, culture, and competencies. Since high consequence incidents occur rarely, the logic is that we need to monitor the more frequent, no or low consequence 'weak signals' – as leading indicators - so that we can fix these weaknesses and prevent the higher consequence incidents. However, the ratio of less to more severe incidents is variable across companies; no constant ratio exists.[9,10]

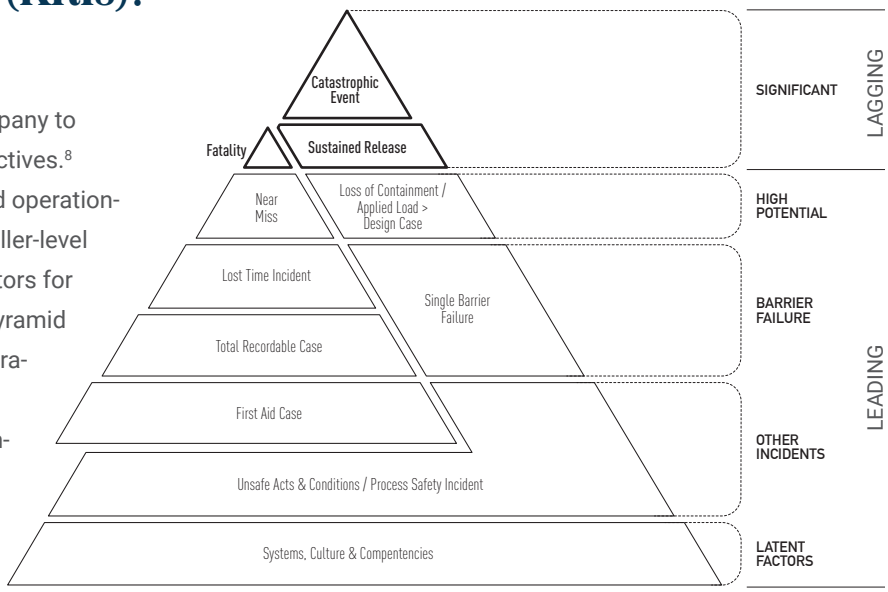

Fig 1: Hypothesized relationship of Occupational Health and Safety (inset pyramid) and Process Safety (larger pyramid) leading and lagging indicators

So, if you see this pyramid, be highly skeptical as it does not map specific leading indicators to specific lagging outcomes.

Instead, to be most effective, you need to tie KRIs to your company-specific list of major incident hazards— the catastrophic, completely unacceptable credible worst case, company-killer loss of control/ containment scenarios (facility explosion, dam failure, crane collapse, sawmill fire, financial data breach…). Ask your risk/operational subject matter experts to map the potential causes,[11] potential outcomes/consequences,[12] and the prevention and mitigation/ recovery controls, for each loss of control/ containment scenarios, say as a Bowtie Diagram (see Fig 2).[13]

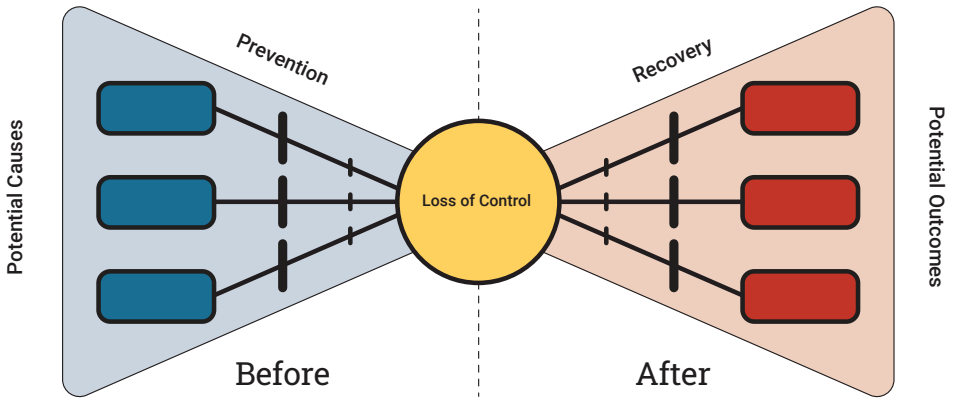

Fig 2: Illustration of loss of control/containment scenarios, causes, consequences, and controls as a Bowtie Diagram

Once you understand the causes, consequences, and controls for each loss scenario, then you can create KRIs that are understandably connected to the presence or elimination of causes,[14] the efficacy of preventative and mitigative controls, and the human and organizational factors that degrade these. This also creates a line-of-sight to corporate strategy, so that managers can see how their real-time (input, process) decisions directly relate to (output) corporate performance.

OTHER GOOD PRACTICES FOR DEVELOPING YOUR KRIs ARE TO:

- **Make common across business units** – so that everyone has common definitions and understandings of risk causes, consequences, and controls.
- **Qualify the quantitative** – i.e., how GOOD an activity is done, beyond the number of times it was done. For example, rather than counting the number of pretask plans done, you can measure how many people contributed to the pre-task plan. Or better yet, did you have turn-taking in your pretask plan meeting (conversation analytics like FactorLab's can do this), that measures if everyone felt comfortable enough to speak up and contribute (a proxy for psychological safety and information sharing).
- **Measure the relationships between tasks and resources** - like safety:efficiency, say with time to resolve deficiencies. Composite indicators, like ratios, do this well and inform your resource planning.
- **Be tied to your greatest human and organizational vulnerabilities** – i.e., hazard identification, contractor coordination, management of change, communication, psychological safety and information sharing, task and relationship competency
- **Not be gameable** – i.e., if I am rewarding reduced frequency of incidents, like lost time injury rate, this suppresses incident reporting

How can you declutter to the essential KRIs?

In the case of key performance/risk indicators, more is not better.[15] So, how can you begin to declutter? Start by asking risk/operational subject matter experts to create an enterprise-level summary table of all your KPIs / KRIs (in rows, as you'll need a surprising number of rows) across all business units' levels (in columns). Include the definitions, equations, and data sources for each. While this might seem tedious, it will give you the granularity to 'see' the (in)consistencies and redundancies. Correct the inconsistencies. And delete the redundancies. Then, evaluate the remaining indicators against the two bullet lists of criteria - 'best leading indicators' and 'other good practices' – and refine the remaining KRIs.

For additional due diligence, if you have the data, you can take a machine learning approach and evaluate every leading indicator for its ability to predict the frequency and consequences of incidents, as we've done.[16]

In sum: Key Risk Indicators (KRIs) provide incomparable leverage for integrating and managing operational risks and creating sustained competitive advantage.

BY EVALUATING, SUPPLEMENTING, AND REFINING YOUR EXISTING PERFORMANCE INDICATORS, YOU CAN CREATE A LINE OF SIGHT AND BEST EQUIP ALL LEVELS OF LEADERSHIP TO ALIGN THEIR DAILY DECISIONS WITH STRATEGIC GOALS.

Take action now to protect and enhance your organization's performance, contact: →

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1 "Push the problem locomotive to the next terminal, they can fix it."
2 Railroaders use their initials when signing.
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6 Borovik, D., Solomon, M. & Kozler, C. (2021) Key Risk Indicators. Chapter 10. In Fraser, J.R.S., Quail, R. & Simkins (Eds.) *Enterprise Risk Management: Today's Leading Research and Best Practices for Tomorrow's Executives, 2nd Edition.* Wiley.
7 Only 32% of companies report using leading indicators to prevent incidents, per Sphera's *2021 Safety Report*.
8 AlOthman, R.A., Key Risk Indicators & key Performance Indicators: Is the difference important? *International Journal of Management and Commerce Innovations* ISSN 2348-7585 (Online) Vol. 11, Issue 1, pp: (400-402), Month: April 2023 - September 2023, Available at: https://doi.org/10.5281/zenodo.8305860
9 Marshall, P., Hirmas, A., & Singer, M. (2018). Heinrich's pyramid and occupational safety: a statistical validation methodology. *Safety science*, 101, 180-189.
10 Hallowell, M., Quashne, M., Salas, R., MacLean, B., & Quinn, E. (2021). The statistical invalidity of TRIR as a measure of safety performance. *Professional Safety*, 66(04), 28-34.
11 Also known as Fault Tree Analysis (FTA)
12 Also known as Event Tree Analysis (ETA)
13 Bowtie Diagrams are intuitively understandable illustrations of a cause-effect diagram and how KRIs connect. See Center for Chemical Process Safety (CCPS) (2018). *Bow Ties in Risk Management: A Concept Book for Process Safety*. https://www.aiche.org/ccps/resources/publications/books/bow-ties-risk-management-concept-book-process-safety
14 Causes might be external like environmental conditions (freeze/thaw cycles, increased precipitation, ice storms, forest fires) or economic conditions (increased tariffs, labour shortages), which require external data sources. Or causes might be internal like changing operations (feedstock characteristics, startup/shutdown) or changing management (budgeting/ resourcing, workforce shortages, competency), which can rely on internal measures.
15 Lim, H.W., Linguard, H., Zhang, R., & Pirzadeh, P. (2025). Decluttering Safety: A Multistakeholder Approach to Enhancing Safety Management in Construction, Position Paper. SHINe (Safety and Health Innovation Network) RMIT University. Available at: https://www.rmit.edu.au/content/dam/rmit/au/en/about/schools-colleges/property-construction/shine/shine-safety-clutter-position-paper-final.pdf
16 Rana, P., Sattari, F., Lefsrud, L., & Hendry, M. (2024). Machine learning approach to enhance highway railroad grade crossing safety by analyzing crash data and identifying hotspot crash locations. *Transportation research record*, 2678(7), 1055-1071. https://doi.org/10.1177/03611981231212162