NATIONAL SAFETY COUNCIL®

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ELEVATING EHS LEADING INDICATORS:

From Defining to Designing

EXECUTIVE SUMMARY

This Campbell Institute white paper is the latest report in its continuing research project on leading indicators. Previous reports have defined leading indicators, outlined the current state of leading indicator practice in world-class organizations, and produced a detailed matrix of environmental, health, and safety (EHS) indicators and metrics. In this paper, the Campbell Institute provides a closer look at the experiences and history of eight Institute members and partners regarding their journeys to develop and implement leading indicators at their organizations. The sections of this report describe:

- Common broad themes and key elements from Institute member and partner organizations for leading indicator implementation along a "Plan, Do, Check, Act" model,
- Areas of differing opinion regarding adoption of leading indicators, and
- Brief case studies detailing each organizational participant's journey to leading indicators

When it comes to choosing, tracking, and analyzing leading indicators, research participants had many areas of agreement. A common piece of advice reflective of their experiences is for an organization to look at what it is already measuring, as these data points could be seen as predictors of future incidents. Also recommended is that an organization not spend too much time deciding which leading indicators to track; it is difficult to know the value of an indicator until it has some traction. Leading indicators should also tell an organization something meaningful and actionable in order to justify its continued tracking.

As may be expected, all research participants were in firm agreement that obtaining leadership support for leading indicators is essential to their implementation. One recommendation for how to achieve this is to talk to leaders about risk mitigation and decreasing the risk to workers and the organization as a whole. When it comes to the safety management system in general, most participants believe that leading indicators are an integral part of the management system, not just a separate program. Any successful safety management system will have a balance of leading and lagging indicators.

The divergences between research participants are few, but raise some interesting issues and points for future discussion. Not all participants are in agreement that near misses be considered leading indicators, or that individual sites should have some agency in determining their own leading indicators. There is also not consensus that leading indicators should be tied to leadership's performance evaluations. These differences among Institute participants demonstrate that while commonalities exist, every organization's journey is slightly different, and a strategy that works for one may not be relevant to another.

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KEY TAKEWAYS

1. Look at what is already being measured; could it be a leading indicator?
2. Just get started; don't spend too much time deliberating
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4. Obtain leadership support
5. Integrate leading indicators into the overall safety management system

INTRODUCTION AND BACKGROUND

For the past two years, the Campbell Institute has been conducting research on environmental, health and safety (EHS) leading indicators defined by the Institute as proactive, preventive and predictive measures to identify and eliminate risks and hazards in the workplace that can cause incidents and injuries. The research has so far followed a measured path to understanding leading indicators, explaining their importance, and providing specific examples, as detailed in the following three stages:

DEFINE: deriving a definition for leading indicators and identifying important attributes for effective leading indicators

ALIGN: describing the current state of leading indicators, including how leading indicators are used and the common enablers of and barriers to leading indicator implementation

REFINE: producing a list of leading indicators, their definitions and specific metrics of each leading indicator

During the "Define" stage of its research on leading indicators (see Campbell Institute white paper, *Transforming EHS Performance Measurement* through Leading Indicators), the Campbell Institute presented a definition of leading indicators as developed by a an expert panel of environmental, health, and safety executives and described key characteristics of successful leading indicators. In a follow-up to this expert panel discussion, the Institute entered the "Align" stage, which consisted of a survey of EHS executives in Campbell Institute member organizations. Through this survey, respondents identified several key enablers of effective leading indicator implementation and use, including C-suite endorsement of leading indicators and thorough communication of leading indicators' predictive value.

The results of this survey revealed several common barriers to leading indicator implementation, including difficulty in developing consistently actionable leading indicators, lack of a reliable relationship between leading and lagging indicators, and sporadic non-standardized benchmarking of leading indicators. To address these concerns, the Institute entered the "Refine" stage of its research (see Campbell Institute white paper, *Practical Guide to Leading Indicators*), which consisted of a collaborative benchmarking project among Campbell Institute members and partners. Specifically, Campbell members worked together to produce a list of leading indicators, their definitions and specific metrics for each indicator.

While it is of interest to know the types of leading indicators and specific metrics tracked at world-class organizations like Campbell Institute members and partnersa pressing issue expressed by many users of the research is how to get started in implementing a leading indicator program. Thus, the next stage of this research describes the various paths that eight Campbell Institute members and partners took in their leading indicator journey and outlines their commonalities and important lessons learned along the way.

DESIGN: developing and implementing plans to deploy, evaluate, and improve leading indicators

While each organization has followed its own path in developing, tracking and acting on leading indicators, it cannot be ignored that there are many broad similarities in organizational experience and history that led to leading indicators' adoption and continued success. This Campbell Institute white paper examines the experiences of eight Institute members and partners, making note of their common points along the journey, key insights and lessons learned.

METHODS

Data collection for this project took place between February and May of 2015 through a combination of one-hour interviews with Campbell Institute participants and peer-to-peer presentations to the Campbell Institute Leading Indicators Workgroup. During these presentations and interviews, participants explained how their respective organizations decided they needed to use leading indicators, how they identified leading indicators to track, and what their leading indicator data has revealed to them about their safety management systems. Some key interview questions include:

- Was there a specific event or incident that inspired leaders to track leading indicators?
- What kinds of elements should be in place to begin implementing leading indicators? Whose buy-in is necessary? What are the roles and responsibilities?
- How does an organization measure the effectiveness of a leading indicator?
- How were leading indicators presented to higher-level leadership? Who needed to be convinced of the efficacy of leading indicators? How was this done?
- How are indicators chosen? How often are they reviewed?
- Is the effectiveness of leading indicators communicated across the organization? How so?
- What are some key lessons and takeaways from this experience? Looking back, would anything be done differently?

The interviews generally followed the above structure but also allowed for additional individualized follow-up questions. Similarly, the question-and-answer session following a participant's presentation to the Leading Indicators Workgroup was a freeform discussion. Campbell Institute staff transcribed all interviews and presentations and performed a content analysis to identify the broad themes and commonalities among Institute participants.

RESULTS

Common practices and words of wisdom

CHOOSING, TRACKING, AND ANALYZING LEADING INDICATORS

Research participants agreed that one way to decide which leading indicators to track is to look at what an organization is already measuring and if any of those pieces of data could serve as predictors of future incidents. A bonus for this approach is that analyzing data that are readily available will not task work sites with the burden of providing information beyond what they are already tracking. One example of this comes from Schneider Electric, which had been keeping records on the number of training hours completed since the early 2000s, but started tracking training hours as a leading indicator at the corporate level only a couple years ago.

The "bottom-up" approach to leading indicators should not be discounted, as both Schneider Electric and Johnson Controls can attest. The tracking of training hours as a leading indicator was first adopted at individual Schneider Electric sites before being rolled up to corporate. Similarly at Johnson Controls, there were many best practices within individual business units that became adopted at the corporate level and were eventually incorporated into Johnson Controls' global maturity model for health and safety. The lesson here is to look within an organization for best practices that can potentially be implemented company-wide.

Several participants mentioned that an organization should not spend too much time nailing down the "perfect" leading indicator, mainly because a universal perfect indicator does not exist, and also because it is impossible to know the value of an indicator until an organization gives it a chance. Knowing that most leading indicators will have to be adjusted in the future makes it even more practical to just start somewhere. This is the lesson from Cummins, which spent the better part of a year deciding which leading indicators to track before finally starting with health and safety assessments and corrective and preventive actions. These made the most sense to track because data in these two areas were readily available and individual sites were already collecting this information.

Akin to "just starting somewhere" is the advice to start simply and small. Beginning with just a few leading indicators allows those in the organization to become accustomed to tracking them without becoming overwhelmed, creating more overall support for leading indicators in the end. As Tom Daniel of Owens Corning states,

"Be careful about having too many leading indicators right out of the gate. You have to establish a cadence around this so people understand what it is you're trying to do and why you're collecting the data before you start collecting lots of it. You need to get a lot of buy-in by keeping it somewhat simple to start."

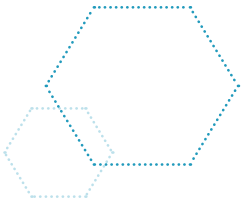
Harkening back to the first Campbell Institute white paper on leading indicators, several participants mentioned that leading indicators should provide meaningful information in order to justify their continued tracking. Jeff Ruebesam of Fluor evaluates an indicator as meaningful if one can answer affirmatively the following questions: "Can you measure it? Does it give you a clear signal of being important to safety? Is it helping you eliminate the defects you hope to avoid?" In other words, a leading indicator should provide a clear path forward in terms of action on how to improve safety. Tracking indicators without using that information to make decisions becomes just a data collection exercise according to Tom Daniel of Owens Corning: "If you're not taking action when your leading indicators are saying that you have risk or elevated risk, then you might as well not do the program."

Some participants cautioned against calculating a hard return on investment for leading indicators, as doing so is highly subjective and may inadvertently drive the wrong types of behavior in employees and management. A better way to justify the use of a leading indicator is to ask, "Does this make sense? Is this the right thing to do?" (Erick Walberth, Schneider Electric).

MANAGEMENT AND EMPLOYEE BUY-IN; ROLES AND RESPONSIBILITIES

All research participants agreed wholeheartedly that obtaining leadership buy-in on leading indicators is absolutely essential to their implementation and tracking. This point is especially made through an example from U. S. Steel, where renewed leadership support resulted in the reemergence of leading indicator tracking after a two-year hiatus. Other participants such as Fluor, NASA, Johnson Controls, and Cummins noted that it was primarily top executives that put forth the concept of leading indicators to the rest of the organization, making the obtainment of leadership support easy.

A couple of participants made note that in order to get buy-in on leading indicators from different parts of the organization (management, frontline workers, engineers, etc.), one needs to have the ability to speak "different languages" to appeal to these different groups' sensibilities. Jeff Ruebesam of Fluor states, "Most people understand the concept of identifying and managing risk. Would you rather be chasing incidents or would you rather be proactive about addressing hazards? No matter what function you're in, you can wrap your head around that." Steve Lilley of NASA notes that in order to make the case for leading indicators to engineers, one must be able to demonstrate technical knowledge:



"You must have the technical chops to sit with engineers and argue for the safety and protections of workers and the public. It comes down to competing requirements for different aspects of a system – cost, schedule, and prestige all compete with safety. You have to go in and present your requirements to build into the system."

Many participants recommended involving multiple departments and functions from the organization in leading indicators, as this elevates the entire company culture around EHS. Besides the safety functions, Institute members and partners made sure to involve human resources, operations, facilities/maintenance, finance, legal, etc. At Owens Corning, for instance, the time it takes to replace a senior leader at a plant (typically a human resources function) may be an important leading indicator of a spike in injuries or incidents. Until these other departments are involved and part of the discussion on leading indicators, many may not realize how their functions can directly or indirectly affect environment, health, and safety at their organizations.

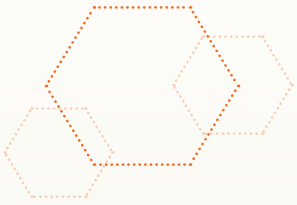
LEADING INDICATORS AND THE SAFETY MANAGEMENT SYSTEM

Several organizations in the research project mentioned that they decided to track leading indicators in the face of increasingly smaller improvements to the lagging indicator rate. As world-class, high-reliability organizations, it was getting increasingly more difficult to improve upon incident rates that were already very low. Identifying and measuring leading indicators offered a way to proactively and positively affect the incident rate.

Another reason for adopting leading indicators was that an intense focus on lagging indicators can unintentionally drive the wrong behaviors in employees and management, causing individuals to lose sight of what is really important – the prevention of injuries and illnesses. Glenn Murray of ExxonMobil says that being overly focused on the recordable rate can discourage behaviors around learning and prevention. U. S. Steel mentions that before the implementation of leading indicators, employees became caught in a "one or none" game: when the incident rate is already quite low, just one recordable incident is the difference between meeting a performance goal and not doing so. Adopting leading indicators gave individuals more opportunities to meet performance goals and encouraged a proactive attitude regarding incidents and injuries.

Several organizations mentioned that in order for leading indicators to be truly effective, they have to be integrated into the overall safety management system and not treated as a separate program. This is the major reason why Johnson Controls includes EHS leading indicators as an important component of its global maturity model for improving business excellence and why every research participant tracks leading indicators at the corporate level. As Glenn Murray of ExxonMobil states, "In order to be effective, you don't necessarily need a leading indicator 'program'. Leading indicators should be integrated into the management system."

While leading indicators have been established as a critical part of a safety management system, they still need to be balanced with lagging indicators to measure their success. A renewed focus on leading indicators does not mean that incident rates no longer matter; lagging rates can still provide clues to the overall functioning of a safety management system. Michelle Garner-Janna of Cummins states:



"You need a mix of leading and lagging indicators. Without the lagging indicators, it would be more difficult if your leading indicators were being effective. You can see whether they're driving the right behavior and reducing risk. It's helpful to compare them to the lagging indicators to determine their effectiveness."

PLAN

– Inventory and leverage existing metrics

– Decide how to measure performance

– Develop a communication plan for leading indicators

– Obtain input and support from management

– Determine stakeholders/roles and responsibilities

"Take just about any of the best-intentioned/designed metrics; nearly any one of them can drive potentially unintended behaviors if they are not accompanied by the appropriate leadership and culture. It's important to consider not only the metric design element, but also the cultural aspect. You need to have those two aligned"

Murray, ExxonMobil

"Because leading indicators were designed in a simple way, we were able to communicate sensibly about why we were doing it. This is very important – we had follow-up conversations about containment actions that we wanted to challenge or discuss. Without that communication element, we would have simply been collecting data, putting it in a spreadsheet, and putting a poster on the wall. Dialogue, conversation, and simplicity were the most important pieces"

Zimmerman, Owens Corning

"We would probably deem this leading indicator process a failure if several years from now those are still the same indicators. Do we need to get rid of those that don't correlate and add new things? Or are we going to develop ways to measure things that we currently don't have a good method for measuring? These will evolve over time; they won't be stagnant. We're going to find some that work and don't work, but we'll find different measures, get the data in, and start measuring that"

Walter, Owens Corning

ACT

– Take action on lessons learned

– Redefine leading indicators or change how they are measured

– Add to existing leading indicator suite

– Rethink leading indicators that are not providing useful information

– Institutionalize changes made

"One thing that we're focused on is this perspective that safety truly has to be owned by every employee. Every single person in the organization has to have this responsibility. We have to not just focus on the health and safety specific leading indicators, but look at what other functions are doing and how that impacts safety. I think that leads to improving the culture and encouraging all employees to take responsibility for safety"

Garner-Janna, Cummins

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- Involve multiple departments and functions (EHS, HR, finances, operations, legal, maintenance, etc.)
- Begin with just a few leading indicators to address key risk areas
- Outline program execution expectations for each organizational level

"Are you avoiding the creation of that risk? If you can answer yes, I would say that your leading indicator is working. It's helping manage an issue that needs to be managed a certain way effectively. I look at it as defect reduction. Is it helping you eliminate defects in operations? If the answer is yes, it's working"

Ruebesam, Fluor

"You might think you're measuring the right leading indicators. But if you keep measuring them but your lagging results don't improve, that either means you're measuring the wrong things or you have execution issues. That's often the challenge with leading indicators. They can be frustrating and you might not select the right ones the first time. The bottom line is you never know until you try it. You need to test the value of it because it takes effort. If it doesn't add value, you shouldn't measure it"

Murray, ExxonMobil

3 CHECK

- Use lagging metrics to evaluate leading indicators
- Ask important questions to assess leading indicators
  (Are they providing meaningful information?
  Can you act on that information?
  Do they give a clear signal for a path forward?)
- Assess how well risks are being controlled

- Solicit input from stakeholders

AREAS OF DIVERGENCE

Not all organizational participants agreed on every strategy for developing, adopting, and tracking leading indicators. Rather than this being a sign that high-reliability organizations do not share many practices, this is an indication that HROs in diverse industries with different customer bases must forge their own paths to find strategies that work best for them. Below are three areas where participants had different experiences or opinions regarding leading indicators.

SITE FLEXIBILITY IN DETERMINING LEADING INDICATORS

At issue here is whether individual worksites should have flexibility in defining the leading indicators that they track, or if all leading indicators should be determined at the corporate level. The rationales for both sides each have their merit. On the one hand, maintaining separate audit tools and recording systems for individual sites tracking their own leading indicators can be cumbersome and lead to overwhelming amounts of data. Allowing each worksite to track its own leading indicators can also reduce the level of comparability between sites. This can make it difficult for the corporate level to aggregate data and obtain a clear picture of what is occurring at each site and across the company as a whole.

Those organizations that allow sites flexibility in defining their leading indicators argue that doing so makes individual sites more agile and effective at mitigating hazards, and that allowing sites to develop their own leading indicators can be a way to discover best practices. Individual sites may be at different levels of maturity, which may necessitate different leading indicators. One final argument for allowing sites to determine their leading indicators is that this practice gives sites accountability, responsibility and authority in goal-setting.

NEAR MISSES AS LEADING INDICATORS

There is a difference of opinion on whether near misses reported should be used as a reliable leading indicator. One side of the debate states that near misses do not provide a clear indication of the state of an organization's safety management system. If an organization is experiencing an increase in near miss reporting, this may mean that employees are becoming more observant and vigilant, or it may indicate that workers or the worksite are becoming less safe. Because simply counting the number of near misses does not provide a clear signal of performance, this side would argue, near misses should not be considered a leading indicator. The other side argues that minor incidents and near misses, while still events with consequences, can be leading indicators for major incidents resulting in injuries.

The issue of near misses remains an ongoing debate in the world of occupational safety and health with each side possessing valid arguments. One answer that straddles the two opinions is that near misses can be considered both leading and lagging depending on how they are treated. If the intent is to treat near misses as actual incidents, especially when it comes to mandatory reporting, the near miss itself can be seen as an event with negative consequences and considered more of a lagging indicator. If the intent of tracking near misses is to find weaknesses in a safety management system and improve organizational safety performance, then near misses become more leading in nature.

"Don't miss an opportunity to educate people below the executive or senior level [about leading indicators]. Find ways to show either a positive correlation or a negative correlation at the front lines where people are actually implementing these indicators"

Thomas, U. S. Steel

"Measuring leading indicators by themselves is easy, but may not make a lot of sense. You have to find that correlation that says, 'Yes, this leading indicator is showing a good trend, and at the same time our lagging indicator is showing a good trend'"

Walberth, Schneider Electric

MANAGEMENT PERFORMANCE GOALS TIED TO LEADING INDICATORS

Not all research participants were in agreement that performance on leading indicators should be tied to the overall performance evaluation of an organization's leaders. For some, tying performance evaluation and incentive programs to leading indicators is an effective way of gaining leaders' buy-in and support for leading indicators. Other organizations opine that leading indicators, like lagging indicators, are still subject to "pencil whipping" and may not be effective in actually measuring leadership's performance. Still other organizations note that leading indicators have had management support from the beginning and therefore do not need to be tied to performance goals.

Here it is relatively easy to see that the practices for incorporating leading indicators in performance evaluations depend significantly on an organization's history and experience. For organizations where the executive team initiated the implementation of leading indicators, gaining and maintaining leadership buy-in for leading indicators may not be an issue. Those organizations that had to do more convincing may initially need leading indicators to be tied to management evaluation in order to build support for leading indicators' inherent value.

All told, the divergences between research participants are few and raise some interesting issues and points for future discussion. These differences among Institute participants demonstrate that while commonalities exist, every organization's journey is slightly different, and a strategy that works for one may not be relevant to another.

CASE STUDIES

The following are brief case studies from each organizational participant that outline how they began identifying, implementing, and tracking leading indicators. In addition, participants share how they continue to iterate their processes for continuous safety and business performance improvement.

"There is an intrinsic value in any leading indicator. You have surveys, inspections, and training, which are all great. But from a systematic and strategic planning standpoint, you have to step back and ask, 'Is this making sense? Is this leading indicator giving us the value that we need?' And five years later ask, 'Is this leading indicator still giving us the same value? Do we need to shift?'"

Walberth, Schneider Electric

Establishing standards of excellence

About two years ago, Johnson Controls President and CEO, Alex Molinaroli, announced his vision for Johnson Controls to become the most operationally capable company in the world. After months of internal and external research, the company's Global Manufacturing & Operations Council (GMOC) created the One Johnson Controls global maturity model to increase the operational performance of all 350+ Johnson Controls manufacturing sites around the world.

The global maturity model is an assessment tool that measures the capability of each plant's performance in nine core principles. Each principle is evaluated on a scale of 0 to 5, with 5 being the most mature. While leading indicators were previously embedded in individual business units at the site level, they were not present across the enterprise. Safety and Environmental comprise two of the nine principles In addition to the principles being the primary overarching leading indicator Johnson Controls, embedded within the maturity levels are increasing expectation for growth in other leading indicators such as behavioral observations, leadership tours and employee involvement levels.

To deploy the model, the GMOC involved three operations leaders from each of JCI's primary business units (automotive, power solutions and building efficiency), as well as functional leads (e.g. learning and development, risk management, human resources, legal, finance) and subject matter experts. The GMOC identified the standards, manufacturing practices, characteristics, and metrics for each level (0 through 5) of the maturity model, and then vetted the model's standards and metrics with operations. Because the process involved business unit and functional leads and was built with plant level input, the global maturity model had wide support and acceptance across the organization.

In developing the standards for the maturity model and leading indicators, JCI did not begin from scratch. JCI looked within the organization to find best practices at the business unit level that could be integrated into the maturity model. Johnson Controls also used the previous Campbell Institute white paper for considerations on leading indicators to track and integrate into level 3, which is the minimum level JCI wants to achieve across the board.

Johnson Controls regularly communicates the progress of the global maturity model and leading and lagging indicators to plant leadership teams and operations team members. The GMOC has also provided plant managers a template for communications to relay the progress on these fronts. Regular communication channels are an important way for JCI to maintain support for the global maturity model and leading indicators.

Finding more meaningful indicators

Schneider Electric describes leading indicators as starting "from the bottom up," meaning that several Schneider Electric sites (but not the organization as a whole) had been tracking training hours as a leading indicator of safety since the early 2000s. In 2013, Schneider Electric North America started analyzing training hours as a leading indicator as there appeared to be a strong inverse correlation between training hours and incident rate.

The reason for Schneider Electric's shift in focus to leading indicators is not unlike the reason other Campbell Institute members cite, namely that decreasing an incident rate that is near zero is not a very meaningful goal. The lagging indicators were no longer providing much information on the state of the safety management system, and increasingly leadership and EHS managers were searching for indicators of greater significance. Before the tracking of leading indicators, the only celebrations held at Schneider Electric facilities were for the number of days or months since a recordable incident. While this is still important, sites are also celebrating the number of observations, total number of training hours met, and safety innovations.

Schneider Electric stresses that these celebrations are important to obtaining employee involvement in safety and leading indicators. It is not enough to require tracking of leading indicators for the sake of reporting to corporate. In the past two years, Schneider Electric has learned that explaining the rationale for leading indicators, demonstrating their correlation with lagging indicators, and encouraging employees to commemorate leading indicator achievement are best practices for obtaining employee participation and creating more vigilant workers.

Now that Schneider Electric is two years into using corporate leading indicators, it has found that merely tracking training hours is not enough. Recently, the organization has moved to also measuring the effectiveness of training through checks and quizzes of safety knowledge two, three or four months after the training has been completed. These checks verify not only that the training was completed, but also that workers remember those safety principles months later.

To launch leading indicators at Schneider Electric, the organization made sure to involve multiple functions within the enterprise beyond the EHS team – marketing, sales, legal and human resources. Finance and budget teams also had to be on board to determine how to sustain leading indicators through recognitions and celebrations. The reason for involving so many functions was not only to move practices forward, but to communicate to the whole organization that leading indicators are not limited to health and safety – it is an entire company philosophy for all to embrace.

ExxonMobil

Laying the groundwork for continuous improvement

Leading indicators have long been integral to ExxonMobil's safety management system and reached a new level of significance with the launch of its Operations Integrity Management System (OIMS) in the early 1990s. OIMS is an integrated EHS management system comprised of different components such as management systems for work permits, training, and incident investigation. Each of these systems has both leading and lagging indicators embedded.

In 2014, leadership at ExxonMobil decided that more insightful leading and lagging metrics were appropriate. The most common (and often well-intentioned) leading and lagging indicators can potentially drive unintended behaviors. ExxonMobil embarked on a four-stage project to discover and implement more meaningful leading and lagging metrics that reveal more about how risk is being managed and compel safe behavior.

The first stage involved understanding the current state of leading and lagging indicators at ExxonMobil through interviews and surveys of ExxonMobil employees. This helped the company to evaluate what is currently working and what needs to be improved. The first stage also included a wide search for information on metrics from over one hundred white papers, technical articles, and presentations, as well as interviews with other companies inside and outside of the oil and gas industry The second stage involved drawing up proposals and preliminary designs for recommended metrics. One recommendation is the better use of advanced statistical analyses and tools, such as analyzing rolling averages and upper- and lower-control limits. The ExxonMobil team has developed recommendations for leading and lagging metrics at the corporate, company and site levels and is currently in the process of vetting and reviewing these recommendations with line management and others in the EHS community.

After line management signs off on the recommendations, the third stage involves detailed design of the leading and lagging metrics – what the metrics are, how they are measured, the resources necessary, most effective training methods, cost-benefit analyses, etc. The fourth and final stage will be actually deploying the new suite of leading and lagging indicators. ExxonMobil expects that it will enter the fourth stage sometime in late 2015.

This methodical, project-management approach to deploying a new suite of EHS metrics was a deliberate move on the part of ExxonMobil. This four-stage process was also implemented to develop a sustainable cycle of improvement so that a large-scale corporate project does not have to be launched every time the relevance of indicators needs to be evaluated. This lays the groundwork for a continuous improvement process.

Aside from establishing a more meaningful suite of metrics, another important component of the effort is the leadership behavior element. ExxonMobil has learned that no matter what the metrics are or how they are defined, these indicators can potentially drive unintentional behaviors without the necessary leadership commitment and dialogue. One way that ExxonMobil addressed this is through a leadership training program centered on coaching and messaging, specifically oriented around how to talk about performance metrics and speak about safety incidents in a personal manner. In this way, safety and leading indicators flow directly into career development and the corporate training curriculum.

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United States Steel

Gaining management and worker engagement

U. S. Steel began looking at leading indicators around 2008 for the primary reason that there had been a gradual flattening of the improvement curve. The company realized that asking for a percent improvement on an incident rate based on 1-2 recordable incidents in the previous year was really asking sites to play a "one or none" game in terms of metrics. This situation sparked a dialogue within U. S. Steel and the professional community to devise other ways to measure safety performance, which turned the attention towards leading indicators.

Composed of top operating and functional support leaders, the Corporate Safety Steering Team convened in 2008 to provide recommendations on leading indicators to the Chief Operating Officer. Initially the company began with an 80/20 split of lagging to leading indicators, meaning that 80% of the performance measurement system was anchored in Days Away From Work and Total OSHA Recordable rates and 20% depended on performance against leading indicators. This ratio shifted to 70/30 the following two years in order to give leading indicators more attention and greater allocation. A rudimentary analysis in 2010 showed that 60% of U. S. Steel plants showed improved performance on lagging indicators but at the same time failed to show a direct correlation to leading indicator performance levels which were overwhelmingly at a meets or exceeds level. This lack of correlation was not wholly satisfying to senior leadership and leading indicators were placed on hiatus in 2011 and 2012.

A change in senior leadership in 2013 brought renewed focus to leading indicators as a part of U. S. Steel's goal setting process. In 2014, the organization transitioned to a 60/40 ratio of lagging to leading indicators, the greatest allocation of leading indicators at the time. Four leading indicators contributed to that 40%, and individual sites were given the latitude to define one of those four indicators specifically related to employee engagement activities. Giving sites some authority and responsibility in goal setting around leading indicators worked as an effective strategy to gain more support for leading indicators. In 2015, U. S. Steel sites now have discretion over all leading indicator metrics that they measure with guidance and direction from the corporate level. This approach provides a higher likelihood that the selected leading indicators will have a more direct impact on local safety performance and cultural trends.

Increasing levels of organizational maturity often means the evolution and change of leading indicators, as U. S. Steel discovered. One initial leading indicator tracked was the percent of employees trained in a corporate selected training program, which was not revealing much information on the effectiveness of the effort. The organization instead shifted to other leading indicators with the intent of creating a more direct correlation of process effectiveness and performance such as reducing the number of physical hazards in the workplace.

FLUOR®

Utilizing an existing tool as a leading indicator

Historically, Fluor used various site and business line EHS audit tools to identify task hazards and program implementation deficiencies with the goal of correcting process defects prior to incidents occurring. In 2012, Fluor formally started tracking and reporting company-wide EHS leading indicators through use of a standard corporate audit tool. The tool was created leveraging the audit tools used previously, supplemented with management and employee behavioral elements, and organized in four sections (program development & communication; management in action; employee training, engagement and culture; and field work observations). It was then communicated to leadership and workers as a proactive tool to help identify training and program gaps and properly manage risk. This approach resonated well with all stakeholders. Using a common audit tool has helped Fluor drive consistency and normalize on excellence across all their sites.

In regards to the addition of behavioral elements, Fluor knew from the beginning that leading indicators such as managers' participation in worker orientations and safe work planning were vital to demonstrating management's commitment to safety. Items specific to employees, such as adequate training, proper tools and equipment, and comfort in reporting concerns are important to maintain employee morale, promote a positive EHS culture, and prevent injuries and incidents.

Last year, Fluor performed 107 audits worldwide using the tool. While today's tool looks very similar to the one created in 2012, it is evaluated annually with requirements and expectations updated to reflect current Fluor standards. Some areas have received more emphasis and updates in recent years, such as life critical operations, which was the subject of a large organizational initiative to benchmark and update processes regarding high-impact and high-severity work. Employee engagement activities have also received more emphasis in the past three years because of the importance of fully-engaged employees to site safety issues. In short, it is not necessary to completely revise leading indicators every few years, but it is essential to periodically evaluate them and remember the overall goal of preventing injuries and saving lives.

Conducting correlations to find effective indicators

Cummins began its leading indicator journey with the decision in 2009 to define some leading indicators for the organization. A team at Cummins spent the better part of that year doing research and benchmarking with other companies in an attempt to nail down a perfect leading indicator that would work in each of its business units and regions. To avoid spending more time in this preliminary phase, the team ultimately decided to track to indicators in 2010: health and safety assessments and corrective and preventive actions. The main reason for choosing these two indicators was that these data were readily available at the site level and sites would not be overburdened by gathering additional information.

After tracking these two indicators for a year, Cummins added more leading indicators at the corporate level: total observations/number of observations per employee, percent of employees trained in behavior-based safety, health and safety training hours as percent of total training hours, hours worked per employee, and percent of new employees. After tracking these new indicators for a year, Cummins felt it had enough baseline data to calculate the correlation each of these indicators had on the incident rate.

The results of the correlation analysis were interesting and informative. The Cummins team found that the incident rate decreased as the number of health and safety training hours increased. The analysis of hours worked per employee (a proxy for number of overtime hours) showed that the incident rate tended to increase as overtime work hours increased. Finally, the incident rate also tended to increase with the number of new employees on site. This analysis provided Cummins with key information on how to prevent injuries and illnesses, namely that health and safety training gives employees knowledge to identify hazards and fix any that they find. If a business unit knows that employees will be putting in overtime hours, this may mean that management provides more training or break time. And knowing that new employees pose a higher risk for health and safety may mean that Cummins can reduce its risk with better orientation and implementing a mentoring or coaching program for new workers.

Conducting this correlation analysis was a way for Cummins to evaluate the efficacy of its leading indicators and make the decision to move forward with, change, or let go of certain indicators. If an indicator is not showing a strong correlation with lagging indicators, this may mean that efforts are better focused in another area showing more promise. Cummins knew from the beginning that it wanted its leading indicators to display certain characteristics, namely that they encouraged the right behavior and gave a good indication of practical solutions and actions to take. Performing a correlation analysis helps Cummins to evaluate its indicators on a periodic basis and decide if they measure up to these important characteristics.

The primary lesson learned for Cummins is that there is no perfect leading indicator or perfect suite of leading indicators. It is a continually evolving process that requires analysis and evaluation because indicators will change as an organization matures and progresses on its safety journey. And sometimes an informative and actionable leading indicator can be something that an organization is already tracking. Building upon existing metrics is a simple way to begin using leading indicators.

Analyzing incidents for better preventive measures

Leading indicators at NASA initially began with space flight and high-altitude suborbital research in the 1950s. At that time, leading indicators primarily came from the tests and designed experiments to understand the stresses of flying in the upper atmosphere, flying beyond the speed of sound, and dealing with volatile propellants. As the tests and experiments became better informed, teams at NASA began to formulate better understandings of how precursors work together to result in a successful mission.

During the shuttle program, NASA developed a large database called the Problem Reporting and Corrective Action system (PRACA). Thousands of engineers would input reports into the PRACA system, which included analysis of events, description of anomalies, and corrective actions to be implemented. A centralized part of this database (and what serves as the foundation for today's leading indicators) is the analysis of these reports and what that implies in terms of design, processes, and procedures.

Whereas the operational space flight leading indicators at NASA grew out of operational necessity – complex systems and increasing technology – leading indicators from the occupational safety and health perspective did not become widespread until the early 2000s. At that time, NASA began an initiative called Continuous Risk Management, which is based on the classic "Plan, Do, Check, Act" process of identifying hazards, assessing risk, implementing decisions to control risk, and following up to determine if the actions were effective. The NASA Safety Center's NASA Mishap Information System (NMIS) collects information from near misses and incidents for use in incident and root cause investigations. Teams then isolate the hazards that were present before a near miss or incident occurred to track those as leading indicators of potential future events.

Another leading indicator at the NASA Safety Center is safety training and enrollment in Safety and Mission Assurance Technical Excellence Program (STEP). NASA can track who has enrolled in STEP and their progress toward upper levels of qualification within a discipline area such as system safety engineering. So far there is anecdotal evidence that this type of operational safety training has positively affected the way Safety and Mission Assurance professionals do their work, and that this training may reduce incident rates. In a qualitative sense, the effort that the NASA has invested in leading indicators has garnered respect across the agency, and has brought Safety and Mission Assurance professionals on technical parity with engineers in classical disciplines such as avionics, propulsion and materials.

Tracking correlations to predict risk

Leading indicators at Owens Corning took root at the business unit level in 2013. Troy Zimmerman, Divisional Safety Leader for Owens Corning, saw that some plants were experiencing spikes in injuries and took a look at outside influences that could have effects on recordable injuries. He observed that plants that had experienced a leader or management change appeared to see an increase in recordables a few months later. Similarly, increases/decreases in labor, new build/rebuild projects, and percent overtime were also associated with a delayed increase in recordable injuries. These are a sampling of what Zimmerman and his colleagues identified as "yellow flags" that predict soft risk.

These yellow flags have become leading indicators of possible future events and communicate to plant operational and safety leaders that containment action needs to be taken, whether that is the creation of sub-teams during a rebuild to ensure the core functionality of a plant, or reevaluating a plant's staffing model if percent overtime increases. The process behind identifying yellow flags and using them to predict what was likely to happen became the basis for what is now leading indicators at the corporate level, which were launched in 2014. Percent overtime remains a strong predictor of lagging metrics, and other leading indicators have been instituted, such as on-time completion of preventive maintenance actions and percent of unplanned maintenance activities. At the corporate level, if any of these leading metrics falls outside a given parameter, it is classified as either medium or high risk with containment actions to follow.

To develop and keep support for leading indicators, Owens Corning made sure to involve other functional areas besides the safety department, including human resources, operations, and maintenance as all of these areas have implications for safety. For instance, the amount of time that a senior-level position remains open may have a negative effect on safety, as can the time for a maintenance response. Pointing out these potential effects is a way for other organizational areas to realize how their job functions and the decisions they make can affect the amount of risk at a site or to the organization as a whole.

Currently, leading indicators and the safety management system at Owens Corning are designed to be run at the local level with oversight from corporate as to corrective action and containment plans. The first phase began with several plants in each business unit piloting the program in October 2014. The second phase has each business unit implementing the leading indicator process throughout 2015.

DEFINE

CRITICAL CHARACTERISTICS OF ROBUST LEADING INDICATORS ARE

- **ACTIONABLE**
- **ACHIEVABLE**
- **EXPLAINABLE**
- **MEANINGFUL**
- **TIMELY**
- **TRANSPARENT**
- **USEFUL**
- **VALID**

A LEADING INDICATOR IS **PROACTIVE**, **PREVENTIVE**, AND **PREDICTIVE**

ALIGN

ENABLERS AND **BARRIERS** TO LEADING INDICATOR **IMPLEMENTATION**

ENABLERS

- Executive buy-in (not technical knowledge)
- Corporate-level roll-up and tracking
- Predictive value communicated and understood
- Targeted collection toward specific outcomes

BARRIERS

- Inability to develop consistently actionable metrics
- Lack of reliable, consistent relationship
- Continued C-suite reliance on lagging indicators
- Sporadic, infrequent, non-standard benchmarking

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REFINE

SELECT LEADING INDICATORS BY TYPE

*for full matrix, see *Practical Guide to Leading Indicators: Metrics, Case Studies & Strategies* white paperr

OPERATIONS-BASED
- Compliance
- Risk assessment
- Preventive and corrective actions
- Training

SYSTEMS-BASED
- Hazard identification and recognition
- Recognition, disciplinary and reinforcement system
- Safety perception survey
- Communication of safety

BEHAVIOR-BASED
- Leadership engagement
- Employee engagement and participation
- At-risk behaviors and safe behaviors
- Area observations and walkarounds

DESIGN

DESIGNING AND DEVELOPING A LEADING INDICATOR SUITE

TIPS FOR GETTING STARTED
- Look at what is already being measured; could it be a leading indicator?
- Just get started; don't spend too much time deliberating
- Make sure indicators communicate meaningful and actionable information
- Obtain leadership support
- Integrate leading indicators into the overall safety management system

The transformative force in EHS

DISCUSSION AND FUTURE DIRECTIONS

One way to summarize these findings on leading indicator implementation methods and place them in a broader context is to look at how high-reliability organizations, such as Campbell Institute members and partners, approach EHS issues, and which practices make them most successful. Here "high-reliability organization (HRO)" refers to an organization that is able to manage and maintain a nearly incident-free record despite inherently hazardous conditions with high-severity consequences. In a recent literature review, Lekka (2011) analyzed research on HROs and found that, with relevance to leading indicators, HROs exhibited effective anticipation of potential incidents, a process to derive and communicate lessons learned, and leadership commitment to health and safety.

To anticipate potential incidents, high-reliability organizations need to have a proactive approach to safety. To Roberts and Bea (2001), this means that HROs emphatically seek to know what they do not know by training employees in hazard recognition and empowering them to fix problems. Seeking to know what one does not know also means performing thorough root cause analyses of incidents and near misses to find trends and predict future events. Leveson (2015) argues that in order to truly anticipate potential incidents, organizations need to adopt assumption-based leading indicators, or indicators that based on the assumptions of engineering practices and on the vulnerability of those assumptions. In other words, it is more effective to manage operational risk by considering the severity of a worst-case scenario rather than the likelihood of it occurring. This approach to managing and mitigating risk is important for HROs to justify the use of leading indicators in their safety management system.

Another characteristic of HROs is their ability to effectively analyze and communicate the lessons learned from previous incidents in order to prevent future incidents (Chassin & Loeb, 2011; Roberts & Bea, 2001; Weick & Sutcliffe, 2007). Beyond the lessons learned, it is important for EHS leaders and executives to communicate to employees why leading indicators are crucial for effective EHS management. Hopkins (2009) argues that major incidents like the BP Texas City refinery disaster could have been avoided if management had been better at communicating the broader picture of operational safety and applying the lessons learned from incidents at similar organizations.

Management commitment to health and safety is a third crucial element for implementing leading indicators at high-reliability organizations. Research from Madsen et al. (2006) shows that without motivated leadership to encourage high performance, organizations tend to be content with status quo mediocrity. One can extrapolate from this that without strong organizational leaders to champion the use of leading indicators, safety and health indicators can be expected to plateau or worsen. Researchers have found that effective leaders at HROs are those that drive the values and culture within an organization and demonstrate engagement through safety conversations and walkarounds (Frankel et al., 2006), proactive commissions of audits and investment of resources in safety management (Lekka, 2011).

These key characteristics of high-reliability organizations regarding EHS leading indicators summarize what the Campbell Institute found in the practices of its members and partners. High-reliability organizations in EHS, like the ones described in this report, share several characteristics and approaches when acting on occupational health and safety, leading indicators in particular. Foremost, HROs take a proactive approach to safety by not only making the decision to track leading indicators, but also consistently digging deeper to find more meaningful and better leading indicators. Evidence of this comes from Johnson Controls, where a maturity model was crafted and implemented to help all JCI sites attain functional excellence through leading indicators and other progressive processes. Owens Corning developed and grew a system of "yellow flags" to better predict potential incidents and ExxonMobil is currently in a four-stage project to retool existing leading indicators and derive more meaningful indicators. Cummins' use of correlation analyses has helped it to understand why leading indicators are effective and determine more meaningful metrics.

HROs are also exceptional in effectively analyzing and communicating the lessons learned from leading indicators, which creates more vigilant and engaged employees across an organization. Schneider Electric has done this by communicating the effectiveness of leading indicators to employees and encouraging them to celebrate achievements in leading indicators. Cummins has conveyed the positive effects of leading indicators to all in the organization by sharing the results of the correlation analyses conducted on a regular basis. NASA's analysis and communication of the lessons learned through its PRACA and NMIS reporting systems means that NASA workers are better informed of the hazards and risks that can cause potential events.

Lastly, HROs understand the necessity of management commitment to safety and health in implementing leading indicators. This has been exemplified by U. S. Steel where a change in senior leadership ended up being crucial to gaining support for leading indicators. Fluor added a management engagement section to its audit tool because it knew that this element is an important leading indicator of a safety management system. Johnson Controls' maturity model would not have been created if not for the vision and directive of its CEO and president.

The common pieces of advice offered by Campbell Institute members and partners can be framed by the classic "Plan, Do, Check, Act" model. In the "plan" stage, Institute participants recommend taking inventory of and leveraging existing metrics that an organization may already be tracking. Doing so may reveal that an organization already has data available and would not be tasking worksites by asking them to provide additional data. Also important is to develop a solid communication plan around leading indicators – why they are important and how much there is to gain by being proactive about safety. Most importantly, organizations need to obtain the input and support from upper management in order to effectively implement leading indicators.

In the "do" stage, research participants recommended involving the input of multiple departments and functions, from operations to human resources. When all functional roles understand how they contribute to health and safety, this builds support for leading indicators and raises safety awareness throughout the organization. Another recommendation for implementing leading indicators is to start small with just a few risk-based leading indicators, then building as data is collected and the organization matures.

For the "check" stage, Institute members and partners suggest running correlations of leading indicators against lagging metrics to evaluate leading indicators' effectiveness. These types of analyses can help determine if an organization's leading indicators are providing meaningful and actionable information. Finally in the "act" stage, participants' advice focused on taking action on the lessons learned, which can sometimes mean redefining leading indicators, tweaking their measurement, or eliminating some indicators altogether if they are not as meaningful or actionable as planned. This stage may also mean adding more leading indicators to the existing suite as an organization grows and matures.

As Campbell Institute members and partners continue to move forward with and iterate leading indicators, one obvious future path for leading indicators research is to follow up with these organizations over the next couple years to assess how their leading indicators and safety management systems have grown and changed with added experience and lessons learned. As all Institute participants have noted, gaining knowledge on leading indicators and improving safety management systems is a continuous journey; there is always new information and experience to be gained with the passage of time. As these organizations acquire more knowledge through assessment and benchmarking, the Campbell Institute has a clear path forward to collect and disseminate the best practices of its members and partners to improve the safety of employees and make all workplaces safer.

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ACKNOWLEDGMENTS

The Campbell Institute would like to gratefully acknowledge the individuals who provided presentations, interviews, and feedback to contribute to this report:

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Michelle Garner-Janna |Director, Corporate Health & Safety, Cummins

Darryl Hill | Vice President, Global Health & Safety, Johnson Controls Inc.

Steve Lilley | Senior Safety Engineer, NASA Safety Center

Glenn Murray | Project Executive, Safety, Security, Health and Environment, ExxonMobil

Jeff Ruebesam | Vice President, Global Health, Safety & Environmental, Fluor

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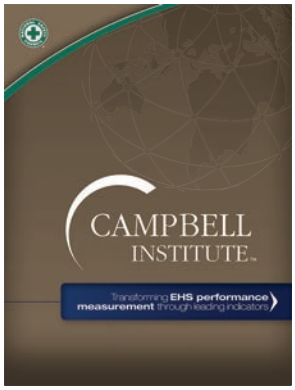
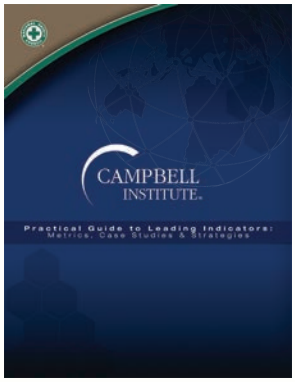
Want to learn more about leading indicators? Check out the Campbell Institute's two previous white papers on leading indicators.



Today, EHS practitioners continue to rely on injury rates, absenteeism, and other lagging metrics despite the growing acceptance of the fact that these failure-focused measures are ineffective in driving continuous improvement efforts. Leading indicators, on the other hand, appear to offer a more useful gauge of EHS activity by providing early warning signs of potential failure and, thus, enabling organizations to identify and correct deficiencies before they mature into accidents and injuries. Among other results, this research finds that management commitment, engagement, understanding, and support are essential to effective EHS performance measurement. Other factors cited as enablers for the implementation of leading indicators were open communication and knowledge sharing, high-quality technology and information systems for data management, linking leading indicators to incentives, and instilling a proactive safety mindset among key staff and stakeholders.



Leading indicators continues to be a key area of interest in the field of environmental, health and safety (EHS). This report describes the second phase of a research project conducted by the Campbell Institute to advance the state of knowledge and practice regarding the use of leading indicators to improve EHS performance. Through group discussions and phone interviews with industry experts, the Campbell Institute constructed a matrix of key leading indicators, their definitions and associated metrics. The matrix represents a collaborative benchmarking effort on the part of Institute Member organizations to catalog of key leading indicators, which can be used as a guide for companies on their journey to safety excellence.

All Campbell Institute research can be downloaded from the Campbell Institute website: **www.thecampbellinstitute.org/research**.

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as of September 1, 2015

About the Campbell Institute

The Campbell Institute at the National Safety Council is the environmental, health, and safety (EHS) Center of Excellence. Built on the belief that EHS is at the core of business vitality and intrinsic to operational excellence and financial performance, the Institute helps organizations of all sizes and sectors achieve and sustain excellence.

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