The journey towards implementation

A necessary condition for introduction of indicators is that the business has a reasonable level of procedures and practices in place to help manage process safety. It is important to note that a system for leading indicators requires a proper level of resourcing in terms of data collection, recording, reporting and review.

Data from existing systems should be used as much as possible as opposed to the implementation of new and costly systems.

Crucial for the acceptance may be the choice between a prescriptive approach and one that allows sites to choose their own relevant leading indicators. This choice need not mean a vast array of indicators that are used across an organisation. Members experience is that, when sites are given a choice in selecting indicators, each independently arrives at similar leading indicators.

It is worth noting that even mature multinational organisations operating with well established process safety practices and reasonable hazard awareness throughout its workforce will take several years to bring to full operation a working system of leading indicators.

Learning by experience

EPSC has consulted with its members on the experience in introducing and using leading process safety indicators. They have shared the following insights.

1. Don't try to measure everything, start with a pilot. Gather experience in collecting the data, educating and involving the end-user and in demonstrating the added value in gaining improvement on the selected topics. Benefit from quick wins.
2. Whenever you use several leading indicators it makes sense to aim for a blend of leading indicators comprising both specific operational parameters and functioning of generic safety barriers.
3. Leading indicators are often expressed as a percentage or ratio and not an absolute value. They should be expressed positively (100% is desired instead of 0%, this is in contrast to lagging indicators). They should promote an informed discussion on where to invest resources (money, effort).
4. 'Compliance Indicators': The use of leading indicators that demonstrate legal compliance is not recommended. Any outcome other than 100% compliance is unacceptable and therefore the indicator is not helpful for steering efforts.
5. For normalisation often the total number of employee and contractor hours in the reporting period is used. It is not directly related to process safety hazards, but is a measure for the scale of operation.
6. Leading indicators originate at plant level where the hazards are. They have a greater relevance for operating staff and lend themselves to a greater degree of involvement from the workforce. Only when there are good reasons to compare plants (within a site), or plants across sites there is a need for shared indicators and normalisation (have a so called common denominator).
7. As with any reporting, it will appear that performance is becoming worse before it improves. Prior to reporting you had an impression of the tip of the iceberg. On reporting the submerged parts become visible. Allow time for sustainable improvement actions.
8. Some companies may link performance as measured by indicators to a bonus. However, this method can be found to become ineffective and irrelevant over time. Under-reporting can be a negative outcome, and employees can begin to focus on the reward rather than a risk reduced workplace. It is better to try to engage staff rather than try to "buy" commitment.

Further reading

1. Developing process safety indicators, UK Health and Safety Executive HSG254, 2006
2. Guidance on developing Safety Performance Indicators, OECD, 2nd ed. 2008
3. Process safety performance indicators for the refining and petrochemical industries, API RP 754, 1st ed. April 2010
4. Process Safety Leading and Lagging Metrics, CCPS, revised ed. January 2011
5. Guidance on Process Safety Performance Indicators, Cefic, 2nd ed. May 2011

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Making the case for leading indicators in Process Safety

Shaping the future of European Process Safety

epsc

Why Process Safety?

Process safety circumscribes those activities within a major hazard environment whose aim is to keep substances within the vessel or pipe. In other words good process safety avoids loss of containment. The consequences of getting process safety wrong include fires, explosions and toxic releases which in some cases result in harm to workers, damage to the environment and business interruption. For a business the benefits of getting process safety right include retaining the license to operate and upholding the principles of Responsible Care in the eyes of the workforce, local community and wider society.

What indicates good process safety? A common pitfall is to see process safety as identical to that of personal safety and use the latter as the sole indicator of workplace safety. Personal safety across industry has enjoyed remarkable improvement in the last two decades and its success is testament to the belief that "what gets measured gets managed". However bitter experience shows that many organisations who have suffered devastating major accidents have in fact reported excellent personal safety.

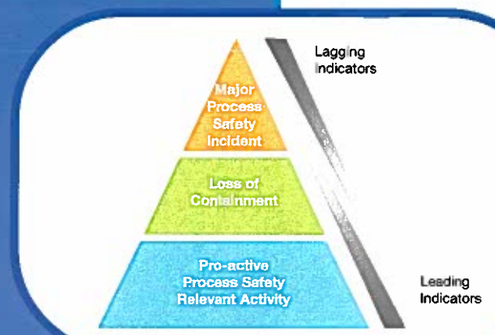
The most obvious measure of process safety is to record losses of containment such as leaks and spills of hazardous substances which can lead to more catastrophic effects. These are described as lagging indicators. Although there is no doubt that lagging indicators are an authentic reflection of process safety they are in essence a reactive measure.

Why Leading Indicators

How can we be more proactive? It makes sense to move down the accident pyramid as depicted and seek indicators that reflect activities which positively impact on process safety. These are described as leading indicators. Leading indicators give confidence and assurance to site and company leaders that process safety is not only under control but also subject to continuous improvement.

Ultimately the bottom line is satisfactory performance in process safety as measured by lagging indicators. Good performance in well chosen leading indicators feeds forward to good performance in lagging indicators.

It is tempting to enter into rather academic debates in an effort to distinguish between leading and lagging indicators. However it is not critical to argue whether indicators are leading or lagging; it is important to be proactive and the focus should be on what they impact, and how meaningful they are in steering actions.



Learning by example

In 2011 EPSC invited its members to share details on leading indicators that each has introduced for process safety. A general finding is that no company uses more than six indicators, and one company uses a single leading indicator as the table indicates

Specific findings

The most commonly found indicators are

Mechanical Integrity

For example the percentage of inspections executed according to schedule, or the percentage of inspections without non-conformities.

Action Item Follow Up

For example the percentage of actions completed by due-date. Differences are apparent in the sources of the action items included in the indicator. Some companies track actions from incident investigation, others include actions from additional sources (e.g. audits and inspections).

Training/Competence

Often this indicator measures process safety training delivered. As an indicator this might be valid provided the training has process safety specific relevance and individual competence is assessed and documented (by test, demonstration, interview, etc). Others use it as an indicator for how complete organisational roles in process safety are defined and assigned. Alternatively you could look at the number of incidents where (lack of) process safety training or competency played a role.

The table illustrates other indicators used that proved to be of value for specific companies in their specific situation. Remember that quality of indicators, not quantity, is more likely to deliver success.

Company	A	B	C	D	E	F	G	Total
Leading Indicator:								
Mechanical Integrity	●	●				●	●	4
Action Item Follow Up	●		●	●		●		4
Management of Change	●							1
Training/Competence	●	●		●			●	4
Risk Assessment		●	●					2
Overriding/Bypassing		●				●		2
Operating Window Excursions		●				●		2
Activation of Failure or Protective Device		●			●			2
Number of Leak Boxes or Clamps						●		1
Operating Procedures (SOPs) / Critical Task Execution							●	1
Number of Leading Indicators	4	6	2	2	1	5	3	

Learning in a specific high risk environment

Despite the fact that we saw that different organisations arrive at similar leading indicators, it is vital to review the risk profile of the process safety activities and pinpoint the specific vulnerabilities. Selected indicators need to be meaningful and reflect the true risk. Only then will efforts to improve be successful.

A starting point is to identify chemical hazards throughout a plant and then to map how the hazard can give rise to a process safety incident. A bowtie model such as the one illustrated is then applied to identify the barriers or key process safety control and mitigation measures.

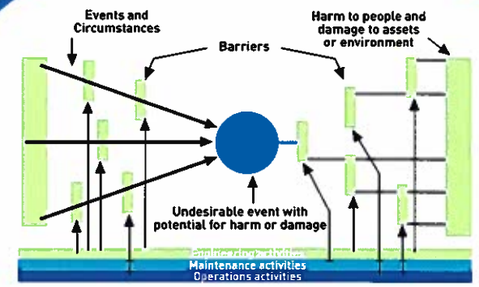


Figure 2: The Bow Tie (courtesy Shell International Exploration and Production)

It is important to select indicators that directly show how well the systems are working in practice.

A typical example is the number of operating window excursions or the number of challenges to a specific safety provision in a given time period. This type of indicator is particularly useful when the process safety risks are concentrated in one specific activity or plant operation.

When process safety risks are found throughout the operations, leading indicators typically are linked to measuring the functioning of critical safety systems or procedures, such as Management of Change, Risk Assessments, Permit to Work, Mechanical Integrity, etc.

For these generic safety barriers it is conceivable to consider indicators that measure completion of a program (e.g. the % of inspections of safety critical plant equipment due for inspection and completed on time in a given period) or the quality of the activity result (e.g. the % of safety critical plant equipment that performs to specification when inspected or tested).

Data for certain indicators may be obtained by reviewing on a sample basis the execution of critical tasks. For example the % of work permits issued in which the hazards, risks and control measures were adequately specified. This offers the possibility to engage workers in peer reviews of such safety critical tasks.

An additional reality check can be done by examining actual process safety incidents. Ask yourself what caused the incident, and which leading indicator would have signalled the need for timely intervention and hence could have prevented the incident.

What to do with the results

Post introduction it is wise to allow the process for collection of indicators to bed down and observe emerging trends. Does the analysis offer any surprises or suggest intervention not only for a specific indicator but also when all indicators are examined as a whole? Are the indicators going in an undesirable direction? Does the analysis invite the use of additional or realignment of resources? Be careful not to be too comforted by desirable movements in the indicators unless they can be substantiated by other sources (actual incidents, auditing, etc). Potential improvement opportunities can be identified by comparing and indeed calibrating leading indicators across different sites within the same business.