Effective Leading Risk Indicators of Future Process Safety Performance

Concepts, History, Development and Lessons

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1st – Generation Process Safety Risk Metrics
2nd Generation Process Safety Metrics

$ PSM $  What We Want
Next Generation Process Safety Metrics

The Perfect Model

Or...a “Live” Model

- Evaluates the impact of day-to-day facility changes and circumstances:
  - User defines equipment that is failed, disabled, degraded etc.
  - Operational adjustments
  - External circumstances
  - Evaluates the increase in impact from these changes

- Requires input from safety/reliability models (HAZOPs, HAZIDs, FMEAs, RAMs) into assessment model

Operator identifies equipment that is failed or out of service

LIVE RISK shows you the increase in risk due to the known equipment failures/ outages or operational circumstances
Swiss Cheese Model for Accident Causation

Figure 2. Leading and lagging indicators set to detect defects in important risk control systems

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Sense, Learn, and Fix at Every Level

Put sensors, not censors, at every level

Develop learnings at every level

Take corrective action at every level
Swiss Cheese Model for Accident Causation

Need to Avoid/Exterminate Poor Culture Rats

Figure 2. Leading and lagging indicators set to detect defects in important risk con

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Metrics Layered within the Pyramid

- # of PS incidents
- # of first aids
- Severity rate

Number of Near Misses Reported

- HSE/PSM audit score
- Number of Overdue Action Items
- Corrective Actions Generated
- Safety Meeting Attendance, %
- Training Completed, %

RC Contacts
- Safety Inspections Completed, %
- BBS at-risk observations

Trend incident and management system technical and cultural root causes as learning opportunities occur

Regular mapping of event cultural causal factor trends

Accidents

Incidents

Precursors

Management System Failures

Unsafe Behaviors and Attitudes

Culture – Individual and Organizational Tendencies
Historical Review of Process Safety Metrics Efforts

Early Efforts to Define/Promote Process Safety Metrics

• Mid-90’s – CCPS R&D on PSM performance indicators: MOC and Training & Performance
• Late-90’s – ACC Responsible Care Process Safety Metrics discussions
• 2001 - CCPS ProSmart program
• 2002 – MKOPSC National Safety Goals Project
• 2005 – 2007 Texas City refinery accident and Baker Panel/CSB reports
Industry-Published Metrics Efforts and Guidance

2003

Developing process safety indicators: A step-by-step guide for developing and using metrics in the chemical process industries

2006

Guidelines for Risk Based Process Safety

2007

Process Safety Leading and Lagging Metrics: A new approach and practical examples

2007

Some Global Trends in Process Safety Performance

2008

Guidance on Developing Safety Performance Indicators

2009

Guidelines for Process Safety Metrics

2010

Tier 1: Upset Concerns
Tier 2: Loss of Containment
Tier 3: Leakage Concerns
Tier 4: Operating Discipline & Management System

2013

OGP Process Safety Indicators Project Model: Environmental Practice on Key Performance Indicators

2013

Safety Performance Indicator Program User Guide

2014

Process Safety Leading Indicators Industry Survey

2014+

Revise RP 754 and Efforts to Harmonize Global Metrics
Needs of Risk Analysis During Life-Cycle of an Offshore Facility

- Design
- Operational for day-to-day tasks - Baseline risk assessment assumptions management
  - TRA/HA for SWPs-JSA
  - MOC
  - Prioritization of actions to remedy asset, human, or management system degradation or equipment deficiencies
  - Residual risk monitoring
  - Live risk applications
  - Analysis of lagging data
Generic Barrier Metrics Approach

- Barrier challenge rate
- Barrier physical condition/functionality measures
- Barrier integrity management via leading indicators
  - Unsafe acts against barriers
  - Failure to fix barrier degradation
  - Failure to identify barrier degradation
  - Failure to imagine barrier degradation
  - Culture degradation
Many are Using Bow-Tie as a Metric Development Framework

The challenge is to determine the “right” risk-important barriers to monitor and then to find discerning indicators of performance/status.
Lessons – Getting Value from Metrics

- Making them up alone doesn’t do anything. Once you see there is an issue, you MUST act. Watching metrics alone doesn’t affect performance.
- Proper refresh rate, consistency/quality in calculations will generate credibility.
- To get 1st-order benefits, make sure they filter through the chain of command to affect the performance of departments and people.
- To get ancillary benefits, you can’t hide them. You must widely advertise them and talk about them to get the culture improvement benefit.
Metrics Advice

- Don’t pick too many
- Make sure they roll up properly
- Make sure they add value
- Don’t just pick things you can measure; make certain they affect accident risk
- Think through how you will use them; anticipate unintended behaviors
- Make them visible – positive culture influence
- Don’t be afraid to change them
Continuous, Sustainable Improvement
in Process Safety Performance Demands…

Effective RCA and corrective action creates improvement

Use of leading indicators to be continuous

Addressing culture and behaviors to be sustainable