

DNFSB Perspective on Metrics and Leading Indicators

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Goals



Understand *leading* and *lagging* safety indicators

Propose a process for determining *leading* indicators

Consider application of process at LANL

- LANL Dashboard
- LANL Investigation Report (LA-UR-07-1035)

Definitions



LAGGING INDICATORS measure events that have already taken place and past trends.

LEADING INDICATORS predict the likelihood of an accident before it occurs, prevent accidents, and support productivity and quality.

Some lagging indicators, when they occur repetitively or in certain combinations, can serve as leading indicators.

Leading indicators are proactive



There is a great benefit in performing casual factors analysis, root cause determinations, corrective actions, investigations, post-mortems, etc...

Many of these efforts improve safety, but may fall short if not fully implemented and verified. For example, the LANL Investigation of Pu contamination events looked at previous investigations and found "... prior corrective actions were not effective (p.54)."

But these efforts have not provided leading indicators.

Leading indicators are proactive.

Leading Indicators (cont)



Leading indicators need to be selected for their predictive ability; they should focus on the health of key programs, processes, and leadership that are relied on to maintain safety of operations.

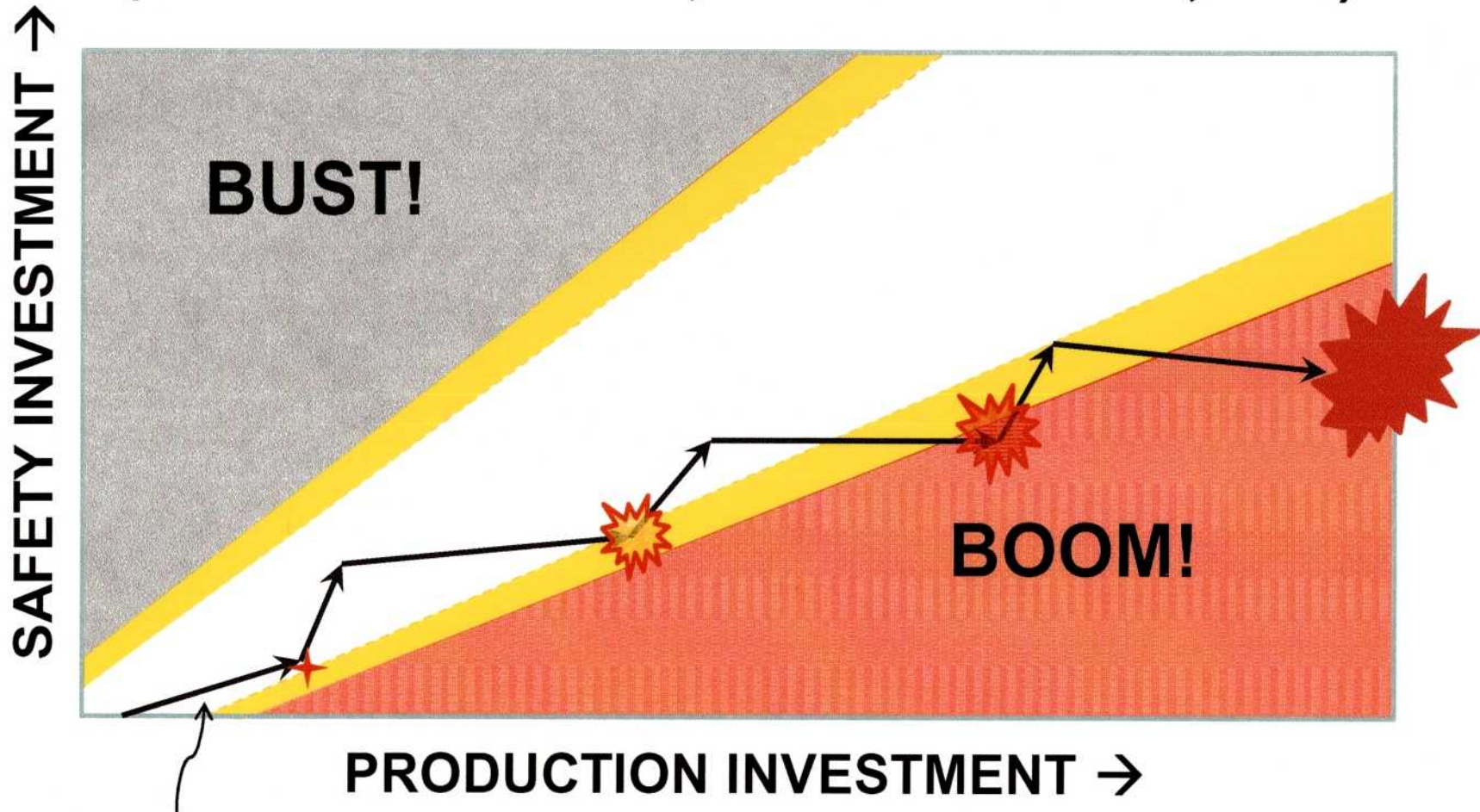
Leading indicators can be identified using a fairly simple approach; many are already measured, but are not recognized as leading.

The selected set of indicators should be updated as programs improve or goals change.

An appropriate set of mission-oriented indicators is needed for comparing trends (qualitative normalization).

A Modified “Reason Model”

(modified from Reason, 1997 and Starbuck, 1988)



The slope and direction of this line is often driven by the organization's desire to “economically optimize” the relative cost of safety in the activity. As safety deficit increases, slope may go negative, leading to more rapid degradation.

3-Step Selection Process for Leading Indicators



1. Select a proper set of goals based on the desired outcome; a hierarchy of high level and intermediate goals may be preferable
2. Identify the institutional or activity-specific programs that are key to meeting each goal; try to focus on the most critical components
3. Determine the metrics that best monitor the health of those key programs; *in the end, it's always people, processes, and equipment.*

LANL Example, Step 1

Select the Goals



LANL's Vision: “Los Alamos, the premier national security science laboratory.”

- Currently there are 12 high-level goals, including
 - “Make safety and security integral to every activity we do.”
 - “Provide efficient, responsive, and secure infrastructure and disciplined operations that effectively support the Laboratory mission and its workforce.” [note the facility safety nexus]
 - “Leverage our science and technology advantage to anticipate, counter, and defeat global threats and meet national priorities, including energy security.”
- Implied desired nuclear safety outcomes:
 - No undue radiological releases to public or environment (Area G);
 - No criticality accidents (TA-55);
 - No worker radiation doses above legal limits (Pu contamination);
 - Balanced priorities between nuclear safety and mission.

LANL Example, Step 2

Identify the Key Programs



Example Programs essential to facility safety goals:

- Nuclear Facility Safety Management Programs (Authorization Basis, TSR, USQD, etc)
- Criticality safety program
- Radiation protection program
- Formality of operations program
- Quality assurance program
- Facility maintenance program

LANL Example, Step 3

Determine the Metrics



Example Safety Leading Indicators

- ST&E Cognizant System Eng. Staffing
- **Preventative Maintenance Completion [facility maintenance]**
- Mean Time to Repair Fire System Impairments
- Deferred Maintenance Cost Savings
- (multiple indicators on DSA quality & status)
- **LIMITS Issues Resolved (and related) [QA & crosscutting]**
- Mean Time Between Significant Events
- Assessments Performing to Plan
- EWMO Facility Availability

Any time your defense-in-depth (SSC's) or safety basis is degraded, there are unsafe work practices that should be tracked and corrected.

LANL Example, Step 3 (cont)



Example Mission Indicators (for comparisons)

- Weapons Infrastructure Status
- SABRS Qualification Unit
- ARIES Integrated Third Demonstration
- Management Risk Determinations (multiple)
- Weapons Program Commitment Issue Indicator
- Pu Oxide Polishing

Desired Observable Trends

- “Positive” – Safety LI’s improve faster than Mission Indicators
- “Stable” – Equivalent improving trends
- “Negative” – Safety LI’s improving slower than Mission Indicators
- “Danger” – Safety LI’s declining.

LANL Dashboard Metrics

that can serve as leading indicators



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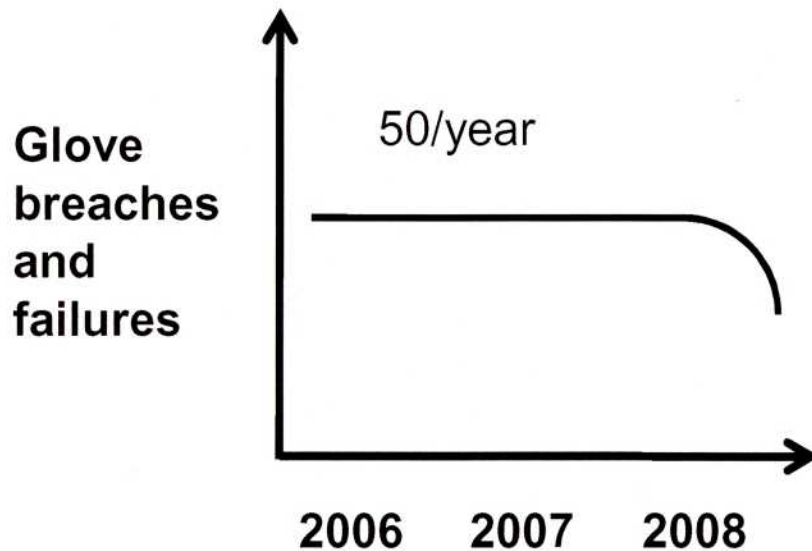
LANL Dashboard Metrics

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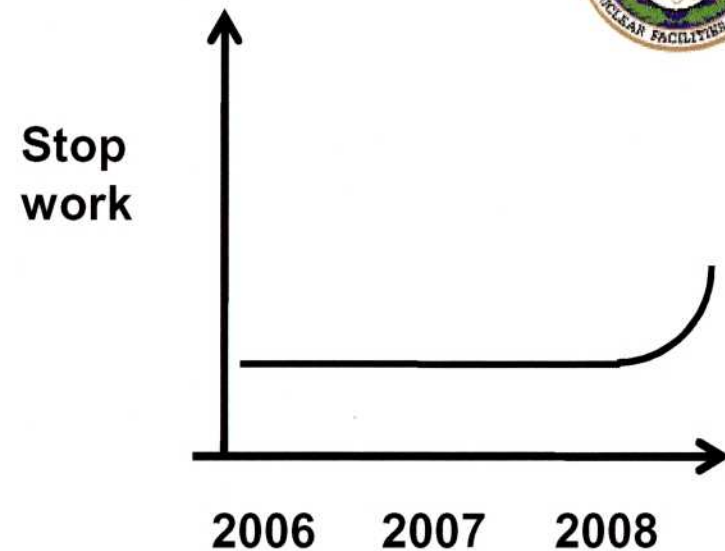


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Leading indicators for January 2007 Pu Contamination Events (LA-UR-07-1035)



GGIP will help eliminate “failures,” but 80% of incidents are acute glove box breaches.



The AIT believes that supervisors and managers ... would not have stopped work;

Expert-based systems make it difficult to stop work;

One machinist repositioned cutting tool during glove donning, but didn't stop work.

Final thoughts



Leading indicators can be used to prevent accidents, while supporting productivity and quality.

Leading indicators are proactive and have increased value for low-probability, high-consequence events. It is difficult to learn from past mistakes when the data is at a premium.

Leading indicators must have a direct connection with the desired goal (e.g., TRC does not measure the quality of a nuclear safety program). The closer the connection to the goal, the stronger the indicator.

Successful nuclear safety programs require committed leadership, sufficient resources, skilled staff, adequate facilities and materials, and well-designed processes.