SPE 171715
Determination Of Leading And Lagging Indicators Utilizing The BowTie Methodology, Arthur Groot

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CONTENT

- Bowtie in a glance
- Performance indicators vs Key Performance Indicators
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BOWTIE IN A GLANCE

- Hazard
- Top Event
- Threat
- Consequence
- Threat Barrier
- Recovery Measure
- Escalation Factor
- Escalation Factor Control

Diagram illustrating the relationship between hazard, top event, threat, consequence, threat barrier, recovery measure, and escalation factor and control.
PERFORMANCE INDICATORS

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SELECTION PROCESS FOR PERFORMANCE INDICATORS

• Performance Indicator (PI’s), selection
  • Per threat line (major vs minor contribution to the top-event)
  • Per consequence line (major vs minor contribution to severity)
• Key performance indicator, extracted from PI’s by using risk matrix

• Key Performance Indicators:
  • **Leading indicators**: “performance of barriers before the consequence”
  • **Lagging indicators**: “number of near misses or the consequences itself”
SELECTION PROCESS FOR KEY (PROCESS SAFETY) PERFORMANCE INDICATORS

Tier 1
- LOPC Events of Greater Consequence

Tier 2
- LOPC Events of Lesser Consequence

Tier 3
- Challenges to Safety Systems

Tier 4
- Operating Discipline & Management System Performance Indicators

Process safety triangle, API 754
6 SELECTION CRITERIA FOR KPI’s

1. Minimum of two barriers or escalation factor barriers must be labeled as Tier 3 and Tier 4 events in the scenario’s that lead to the most severe consequences (Tier 1 event) per BowTie.

2. One Tier 3 or Tier 4 event must be related to influence the likelihood and one Tier 3 or Tier 4 must be related to mitigate the effect in relation to the most severe consequences (Tier 1 event).

3. A selection of approximately 10 key performance indicators per BowTie should provide reasonable cover of the main process inputs whilst still being manageable.

4. The KPI’s should in general cover areas with the greatest opportunity for improvement in relation to the risk (likelihood as well as mitigating the effect).
6 SELECTION CRITERIA FOR KPI’s

5. A consequence can be selected as Tier 2 event as long that it is a precursor with a Tier 1 event.

6. Verify over all the BowTie’s whether Tier 3 and Tier 4 KPI’s can be aggregated and how the reporting of these KPI’s can be standardized and transparent for benchmarking between the assets.

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CONCLUSIONS

1. It is shown in this paper how to determine leading and lagging indicators utilizing the key performance indicator pyramid and the BowTie methodology.

2. The lagging Tier 1 and Tier 2 indicators are in the BowTie model the Consequences and the Tier 3 and Tier 4 KPI’s are shown in the BowTie model as the barriers or the escalation factor barriers.

3. It is recommended to use the thresholds, as defined in the performance indicator pyramid, for the determination whether a consequence is a Tier 1 KPI or a Tier 2 KPI.

4. Finally, it is important always to verify whether each determined KPI is precursor for a Tier 1 KPI.
Acknowledgements / Thank You / Questions

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