The essential elements of pipeline risk assessment

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As the need for better risk management continues, pipeline operators' formal risk assessment methodologies must keep pace in order to remain relevant. This article revisits the essential elements of risk assessment introduced in 2012. This is the idea of developing efficient and appropriate risk measurements to help stakeholders and operators better understand and effectively manage risk.

The inaugural article of this regular column – vintage 2012 – questioned whether formal risk assessments performed on pipelines were truly helping all stakeholders to understand and manage risks. Much has been accomplished since then to help practitioners more efficiently and more accurately measure risk, but the newer ideas and methods have still not yet reached all corners of our industry.

The essential elements proposed back in 2011 have now been tested and battle-hardened; they have proven to be a complete and helpful guide to establishing or judging methodologies. That is why this is a good time to revisit that first article where the essential elements of good risk assessment were introduced.

SUPERIOR RISK ASSESSMENT

As the desire for more robust pipeline risk management grows, so too does the need for superior risk assessment. A formal risk assessment provides the structure to increase understanding, reduce subjectivity and ensure that important considerations are not overlooked; the associated decision making is therefore more consistent and reliable when formal techniques are used.

But has pipeline risk assessment been improving? Not according to some regulators, including in the US, who – since 2011 – have voiced scepticism regarding how pipeline operators are measuring risks.

This column seeks to address this situation by offering insights into risk concepts, especially efficient and appropriate ways to measure pipeline risk. Tackling the specifics of pipeline risk in bite-sized portions will hopefully make this challenging subject more approachable to those not yet well initiated.

We begin with the immediate concern of how to help ensure efficient regulatory oversight.

The Pipeline and Hazardous Materials Safety Administration's recent criticisms are not unjustified. There is currently great disparity in approaches and level of rigour applied to risk assessment by pipeline operators.

This is largely due to the absence of complete standards or guidelines covering this complex topic. The disparity leads to inconsistent and problematic oversight by regulatory agencies.

Without some standardisation, or at least consistency of understanding, auditors cannot readily determine where deficiencies may lie. On the other hand, too much standardisation – a mandated, prescriptive approach – is inefficient and stifles innovation in this complex arena.

INTEGRITY MANAGEMENT

Formal risk assessment is relatively immature in most industries, including pipelining. Many relative risk assessment techniques in current use by pipeline operators were developed before formalised and regulated integrity management programs (IMP) were established.

As such, the assessments often do not meet the demanding objectives of the more recent regulatory initiatives. As the author of one of the most widely used indexing models, I can attest that such models were not designed for many of the applications now envisioned by regulatory IMP or other uses of risk assessment that are becoming commonplace today.

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Due to the simplicity offered by relative or scoring type risk assessment models, their usage became widespread. However, most of the early models will indeed require modifications in order to keep up with the new demands.

A mandated risk assessment approach is not the best solution. That would introduce a prescriptive element with substantial 'overhead' related to the establishment and documentation of the approach's specific requirements.

A better solution is to establish guidelines of essential ingredients necessary in any pipeline risk assessment. Critical elements would be identified and it would be left to the operator's subject matter expert (SME) to detail those elements.

Properly crafted, a defined list of the essential ingredients in a risk assessment would introduce a beneficial amount of standardisation without becoming prescriptive. Specifying that all risk assessments contain, at a minimum, a few essential ingredients ensures that both regulators and the regulated are on the same page.

For example, possible essential elements include the following:

1. A **definition** of 'failure' to accompany a measurement of 'probability of failure' (PoF).
2. A measure of **consequence** potential, separate from the PoF measurement and representative of the full range of possible consequences.
3. Production of a **risk profile** – all failure mechanisms and consequence potential must be measured at all points along a pipeline, showing changes in risk along the entire route. Summary values of risk – aggregating values from point to point – must be producible without masking true risks.
4. Sufficient **resolution** – the risk assessment must divide the pipeline into segments where risks are unchanging. While modern risk assessment routinely produces hundreds of segments per kilometre, a rule of thumb is that less than about 10-20 segments per kilometre is suspicious.
5. All inputs and results must be **measurements** (or estimates) expressed in commonly used and verifiable units. The use of measurements (e.g. events/km-year, mpy, etc.) instead of points or scores reduces subjectivity and complexity (it's actually simpler once the scoring system is discontinued) and allows validation.
6. Measurements (or estimates) of the **three key aspects of PoF** – i.e. the attack, the effectiveness of each of the defences and the resistance to failure if all defences are breached – are required for every failure mechanism. Without an estimate of each PoF ingredient independently, a full understanding of PoF is not possible.
7. A theoretical **remaining life estimate** for each time dependent failure mechanism is required. Without this, how can an integrity re-assessment interval be defensible?
8. A level of conservatism for inputs and other model aspects must be declared. For example, an assessment might reflect P50 (most likely) or, alternatively, P99 (worst case) risks; note that both are useful, but for different applications.

Perhaps we can all agree that, regardless of the specifics of modelling, a list of essential elements such as these must be a part of a proper risk analysis. The essential elements recommended here are actually very simple concepts and easy to implement.

As a side benefit, potential modelling issues surrounding aspects such as 'threat interaction' and 'proper aggregation of risk results' largely disappear when these elements are present.

When all parties agree on what is essential and everyone measures those essential things in some fashion, then everyone is 'speaking the same language'.

A limited amount of standardisation in measuring risk is therefore appropriate and useful to all stakeholders. Expectations are managed, audits run smoother, information sharing is improved and risk management becomes more efficient. P

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For details surrounding the essential elements, see **www.pipelinerisk.net**