Avoiding missteps: risk versus rate of risk

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Forming a strategy to mitigate pipeline risks can be complicated by how the length of an asset impacts the numbers. Data and statistics must be carefully considered and interpreted in light of the 'length' factor. This article discusses a subtle but critical aspect of understanding risk on a long linear asset like a pipeline.

Risk versus rate of risk. Which should drive risk management? What are the implications for acceptable risk thresholds? Let's examine both.

First, let's agree on some terminology. For our purposes here, a rate of risk is a value with measurement units that contain a defined consequence, with a frequency of occurring over time and space. Incidents per kilometre per year; failures per year per metre; fatalities per year per kilometre; and cost per kilometre per year are all measures of rate of risk.

Risk, sometimes called 'total risk', removes the 'per length' (e.g. per kilometre, per metre) aspect. So, risk is expressed in units of $/year, fatalities per year, incidents per year, and so on. Multiplying the rate of risk by length generates risk for linear assets.

Both risk and rate of risk should be readily seen for every inch of every pipeline that has undergone a risk assessment. But once these numbers are generated, it is not immediately apparent how they should be used in managing risk.

This includes location-specific risk management, system-wide risk management, risk strategising (see 'Where is the risk control strategy' in *Pipelines International* March 2015) and all other risk management applications.

Let's see how these different measures of risk impact risk management decision making.

DRIVERS OF RISK MANAGEMENT

The objective of pipeline risk management is to identify and mitigate unacceptably high risks along a pipeline. Regardless of how the decision maker defines 'acceptable', they must first identify candidate locations that may warrant mitigation. Here is where both risk and rate of risk should be consulted.

A pipeline could have a short segment with an extreme rate of risk of US$10,000/km-year. Since it is short, this segment may present only relatively minor risk (expected loss) to the operator: e.g., US$10,000/km-year x 3 m equals US$30 per year.

Does this mean it can be ignored? Perhaps your first inclination is to say 'yes, it can be ignored'. But if all other portions of this pipeline carry only US$200/km-year of risk, does it still seem appropriate to ignore the $10,000/km-year segment simply because it is short?

A pipeline could also have very low risk rates along its entire length, yet present more risk than any other comparative pipeline.

For example, a 100 km long pipeline might show US$8,000/year of risk, compared to a similar 10 km pipeline with US$2,000/year of risk. The longer pipeline has only one quarter of the rate of risk compared to the shorter one and yet, due solely to its length, carries more total risk. Does this mean that only the longer pipeline warrants mitigation?

Note also: these examples illustrate why a risk matrix is not a useful tool in presenting risks from assets like pipelines. A matrix would need to show both risk and rate of risk to be a complete decision support tool.

As with most risk management decision making, there are rarely non-negotiable, undeniably obvious 'correct' answers. These numbers are communicating actual risk information but do not necessarily show what the best risk management strategy should be.

The numbers show different views of the real world risks. Neither can appropriately be ignored, and neither should always dominate the risk management decisions. Both must be used for complete understanding.

Most would agree that it does not feel right to allow very high rates of risk to persist just because those rates only apply to short lengths of pipeline. It also feels wrong to penalise longer pipeline segments, or even entire pipelines, just because they are longer than comparative pipelines.

This brings us to implications for risk thresholds.

ACCEPTABLE RISK THRESHOLDS

The selection of acceptable risk thresholds is normally based on individual risks and sometimes on societal risk. Some sources also cite the use of 'aggregate risk', sometimes also called 'possible loss of life (PLL)' as possible measures of risk.

Putting aside the issue of whether these are actually the same thing, there is a good reason that they are seldom used in setting acceptable risk criteria. Risk acceptability is not logically impacted by facility lengths beyond those that are directly involved in generation of individual/societal risk scenarios.

This is illustrated by an example using roadways.

Consider two roadways, identical except that one is 1 km long and the other is 1,000 km long. Each has the same rate of risk: a vehicle incident occurs every 0.2 km-years. The 1 km road therefore harbours an incident rate of:

1 km x 0.2 incidents/km-year = 0.2 per year or 20 per cent/year – an incident every 5 years.

The longer road carries an incident rate of:

1,000 km x 0.2 incidents/km-year = 200 incidents per year.

The 1,000 km road clearly 'facilitates' (a better word in this case than 'causes') many more incidents per year than the short road. This makes sense: longer roads have more vehicles on them with more chances of accidents.

Does this mean you are less safe on the longer road? Should you only drive on short roads? Of course not. You are never threatened by the entire road simultaneously. Your use of either road is not made riskier by what is happening kilometres away or even a few thousand metres away.

Furthermore, if this 'aggregate risk' concept was taken to a logical conclusion, there would be a highway length beyond which risk is unacceptable. E.g.: we can only build 100 km long highways in order to avoid the possible loss of life associated with highways of longer length.

Aggregate risk is a measure of risk and may have utility in a very few specific applications but it is not an appropriate standalone measure of risk for long, linear assets such as pipeline systems.

GOOD NEWS, BAD NEWS

We can further complicate things by examining the 'time' aspect of risk versus rate of risk. Perhaps some normally unacceptable risks are acceptable for short periods of time?

So, the somewhat bad news is that risk involves challenging concepts and missteps are possible. The good news is that we continue to improve our understanding of risk.

Better understanding means better decisions, which means safer pipelines. **P**

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