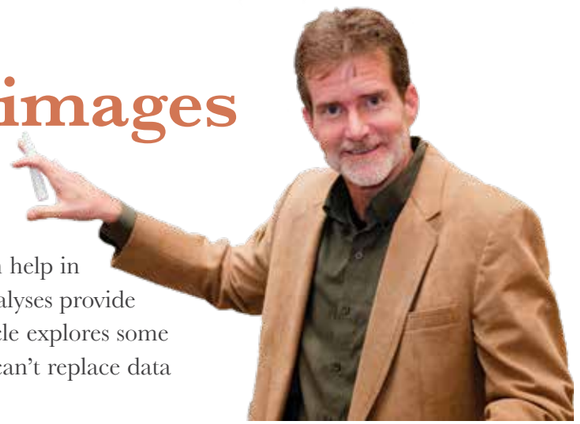
Seduced by graphics: the myth of risk management by images



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While there are a number of visual techniques that can help in interpreting large amounts of data, many graphical analyses provide little to no value for in-depth risk assessment. This article explores some common graphical techniques and discusses why they can't replace data analyses in risk management.

This article continues the discussion from our last column, which covered aspects of 'extracting knowledge from information' – what a powerful phrase! This is the beginning of the natural and necessary move from risk assessment to risk management.

In the pursuit of a deeper understanding of risks, there is a common false trail. This is the misconception that graphics and images can replace data analyses in support of risk management.

While graphics and images certainly can communicate information more efficiently than tabulated data, there are certain essential aspects of the transition to risk management that are most efficiently done by direct data analyses – that is, the use of tabulations of data and basic statistical analyses.

Our last column covered some good places to begin such analyses. In this column, let's reinforce those ideas and also begin to debunk this false trail of 'seduction by graphics'.

Note that there are two main types of risk management of interest to a typical pipeline owner or operator: corporate strategic risk management and location-specific risk management.

The second is, by far, the primary focus of most stakeholders including regulators, operators and the public. Both call for more data analyses and less consultation by graphics. Furthermore, a graphic can actually be harmful; it can display misleading information and/or support a misallocation of resources.

While none dispute the power of the right graphic to transmit information efficiently, there is often too high of an expectation that images alone convey sufficient understanding. This is best illustrated by a tour of some common images that, to some, purport to fully support risk management.

Some are indeed useful and important, while others are quite problematic.

MATRIX

Firstly, let's dispel the notion that a matrix is a risk assessment. At best, it is a presentation tool. Even as a presentation tool, it is especially limited in displaying risks associated with pipelines or other long, linear assets.

The rate of risk as $/km-year, for instance, is often of more interest to risk management than the total risk as $/year. How can the rate of risk be shown on a matrix? Perhaps by a 'cloud' of point values where each point represents a length with a certain rate of risk, but yields no summarisation.

If the total risk is to be shown, then longer assets will show higher risk, even when a shorter pipeline is really the problem.

PIE CHARTS AND BAR CHARTS

Pie charts and bar charts are eye catching, but really show no more than the tabulated values from which they were created. If the advantages of colours, shapes and scaling over simple tabulated values is thought to be high, then perhaps they are worth creating.

However, they do not really advance risk management and suffer from limitations similar to matrices. The exception is when a bar chart is actually a histogram – a useful tool discussed later.

FLOWCHARTS, EVENT TREES, FAULT TREES, BOWTIE AND MORE

These graphics are often interesting representations of the connectivity among scenario elements, but are rarely of use beyond foundational elements from which the actual risk assessments have emerged.

Similar to a matrix, some may initially advertise these as risk assessments themselves. While they can be the underpinnings or the foundations of full risk assessments, they are actually only risk-factor visualisation tools.

As such, they are suitable for presentations, scenario investigation and other drill down type analyses, but are unsuitable for comprehensive compilations of risk information resulting in risk assessment. For instance, how can such images display – much less summarise – multiple failure mechanisms across many kilometres of many pipelines?

GEOGRAPHIC INFORMATION SYSTEMS (GIS) MAPPING

Heat maps against aerial photo backdrops are compelling and engaging. They are legitimately useful when doing location-specific risk management, in somewhat the same way that profiles (risk plotted along pipeline length) are. However, they really only come into play after significant other groundwork analyses has been completed.

For instance, what determines which section of which pipeline warrants the zoom-in to see the changes in risk? Trying to 'walk the pipelines' via GIS/aerial imagery is not a practical option for any but the shortest systems.

Filtering, sorting and prioritising can be done in the GIS environment, but arguably not as efficiently as directly analysing the values in the underlying database.

TOP LISTS

While not exactly a graphic, many often seek a 'top ten' type list. It sounds simple, but this is actually a very tricky thing to create and, if done without sufficient care, can be especially misleading.

For instance, what should this top-ten list be based upon? Longer pipelines will show higher risks when all else is the same. Rate of risk – for example, risk per metre – is a key measurement, but cannot define a collection of components.

Attempts to summarise risk for a collection of components – such as the maximum, average, length-weighted average, and so on – in order to generate a top ten type list is a common misdiagnosis trap.

GRAPHICS THAT PROVIDE UNDERSTANDING

Histograms, profiles and correlations are graphics that actually do, at a glance, convey significant understanding.

Histograms are helpful in that they are useful representations of risk patterns and provide knowledge of the behaviour of data sets, such as the underlying distributions of data.

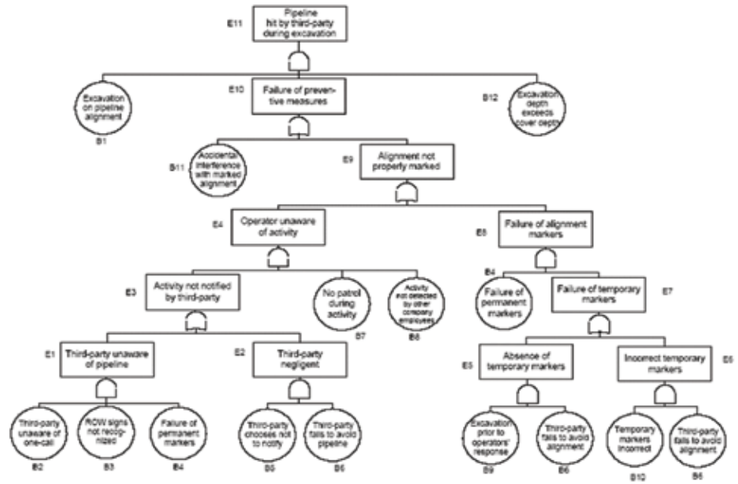
Profiles are plots of risk values along a pipeline and are an essential element of risk assessment. They are the starting points of location-specific risk management and reveal the challenging decisions that must accompany risk management, even when risk assessment is superior.

Correlations and scatter charts are also more than 'window dressing', for the same reasons that histograms are. At a glance, one can see important aspects of central tendency, skew, dispersion and more.

For a more in-depth explanation of analysis techniques that can help an operator use large amounts of data without becoming overwhelmed, please refer to the *Pipelines International* column from the June edition, 'Analyses of risk estimates: how to begin'.

CONCLUSION

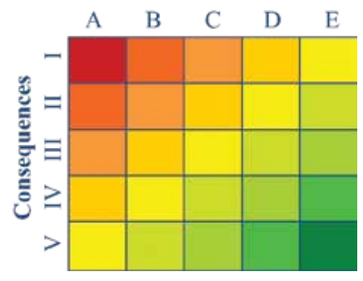
Modern risk assessment generates large amounts of data – that is a good thing! Let's recognise that with a few simple analyses tools we can efficiently extract knowledge from the information. But let's also recognise that 'knowledge extraction missteps' are common and must be avoided in moving from the assessment of risk to the management of risk. **P**



A fault tree.

A pie chart.

A GIS.



A matrix graphic.

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