Modelling RISK

Keven Graham, GeoFields, Inc., USA, discusses the latest models designed for risk analysis.

Most pipeline operators implement a risk model to identify and address sections of high risk pipe. The segments with the highest risk scores are defined and appropriate mitigation activities are planned to reduce the presence of the threat. As industry expertise and data management technologies continue to improve, organisations may need to reassess whether the initial goals of the risk model are still being met and if the calculated risk scores emulate the lifecycle of the pipeline system. Therefore, it is important to be aware of emerging technologies that would allow for continual improvement of the risk model and data management principles, so the organisation can make the best informed decisions about mitigation activities and appropriate response plans. Since it is a significant decision to change risk models, it is important to consider a few key steps.

Resources and requirements

Communication between all active bodies needs to be transparent and effective. Some companies rely solely on their subject matter experts, while others bring in outside contractors. Regardless of who is involved, a clear definition of the risk model, resources, requirements and goals need to be established beforehand. When making the decision to change or revamp a risk model, a number of key questions must be asked:

- Is there enough well managed data to complete a more complex risk model?
- Are the improvements to the risk model well documented and defendable?
- Who will own the risk model and validate the score output?
- Do we want to use a less complex risk model?

Risk modelling requires a candidate with knowledge of pipeline operations and the ability to validate, explain and understand the risk results. This role requires an effective communicator able to build a model with subject matter experts and third party contractors, to explain requirements to the data team, engineering department or field crews, and to defend the results to auditors.

Data management

The most important, but difficult aspect to consider when modelling risk is data management. The field of risk analysis works on the following theory: “If all information is available, then an accurate assessment of risk can be made. The less accurate the data, or the fewer inputs we know about, the less confident we are about our analysis of risk.” Consequently, the less confident we are about risk scores, the less credibility you would put in them when developing an integrity management plan. A data management solution must provide the means to store and manage data that can be easily retrieved, reviewed and appended to, allowing for better business practices for data, integrity and risk departments.

Storage is very important - without it, data management is impossible. Data storage brings all of the data into a central database, and provides the digital information with rules, security and structure.

In data management, the focus is on policies and procedures, which are implemented through software.

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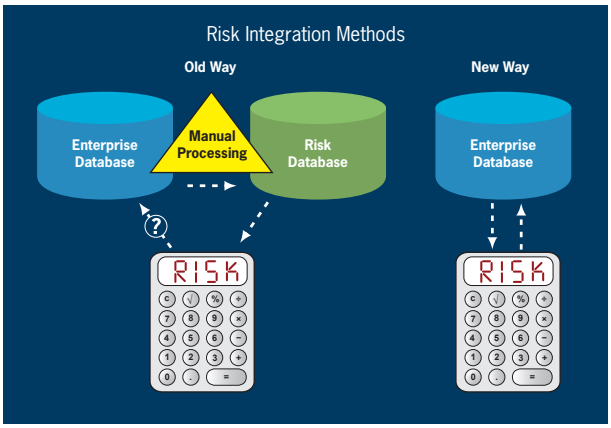

Figure 1. Database integration elimintates the need to pre-process data and makes publishing easier.

Effective data management software for pipeline companies understands the format of the data, often based on industry standard data models, as well as the changes and additions that a pipeline company needs to make. Functions of the data management system should include:

- Adding new pipeline sections.
- Changes in pipeline status (such as planned, active, idle, abandoned, removed).
- Pipeline reroutes, whereby pipe sections become idled and new pipeline sections added in.
- Modifying the pipeline location based on better survey data or a better basemap.
- Managing the facilities that make up the pipeline system.

For example, if a pipeline section is retired, all the components that exist on that section are also retired. If a pipeline's location is updated to reflect a new GPS survey, then all the features that lie on the line must remain in their correct locations on the pipeline.

Data comes from a variety of different sources, including alignment sheets, physical inspection forms, inline inspection (ILI) spreadsheets, GPS files or any other input. With increasingly better data management practices, risk modelling will have access to more accurate data. The key to successful data management software is not only to have data continually added to a central enterprise database, but also have information improved and validated from users at every level of the organisation. The distribution of information can only promote better knowledge of the pipeline system thus increasing the value of the risk model.

Integrating data into the risk model

Historically, pipeline risk analysis was disconnected from the central database, causing someone to collect and manually process all of the information into a specific offline risk database. This method was extremely time consuming, costly, error prone and it often generalised

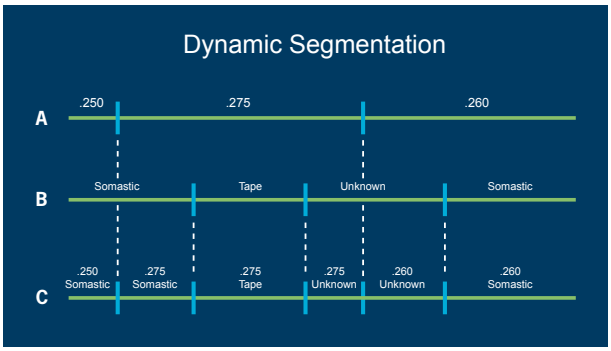

Figure 2. A dynamic segment is created every time a pipeline attribute changes. A) wall thickness; B) coating; C) dynamically segmented pipe.

data into predefined segments. Increasingly, pipeline operators are looking for solutions to connect directly to the enterprise data, thus eliminating the preprocessing of data and increasing accuracy and resolution. The elimination of preprocessing is accomplished by a process called dynamic segmentation. Dynamic segmentation overlays all the attributes for a pipeline and creates a unique linear segment for every change of an attribute. Dynamic segmentation is only possible with advanced risk modelling applications as it allows the user a variety of options to define how data will be integrated into the risk model from the enterprise database. Importantly, dynamic segmentation is not manually created but rather processed at run time, as defined within the risk modelling application.

Dynamic segmentation requires all of the attributes defined as risk factors to be combined into a linear segment. Inherently, some data is not linear in nature and can not be integrated until a point to linear transformation is defined. Different types of data have different risk integration requirements to make the risk factor accurately reflect the threats and consequences of the pipeline. For example, metal loss information is typically collected as points which can be translated into linear segments of varying levels of corrosion. In another example, a valve is typically represented as a point but may be buffered +/- 10 units to account for the exposed area around a valve location to identify potential areas of vandalism.

Spatial datasets are becoming increasingly common as more data is captured with GPS devices, Inertial Navigation Systems (INS) and GIS systems. Therefore, a risk model solution should be able to incorporate these datasets directly into the risk calculation. Structure point locations may be snapped to the centreline or a landuse polygon may be laid over the pipeline to create a dynamic segment. It is important to understand how different spatial datasets can be best used to extract the most value into the risk model.

The ability to integrate both spatial and relational information from an enterprise database will increasingly

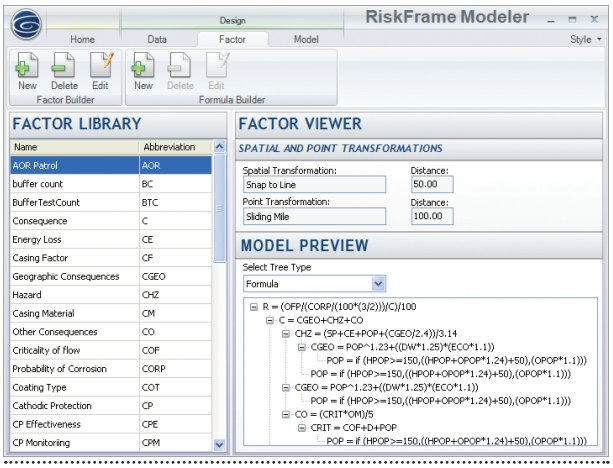

Figure 3. GeoFields' RiskFrame® Modeler.

be desired by pipeline operators to maximise the available datasets used in the risk analysis. The ability to directly access and integrate data into the risk analysis workflow will allow for modelling to become a significantly more accurate, efficient and iterative process. Since the data supplying the risk analysis has improved, the risk results will be more accurate, thus mproving the decisions fueling mitigation activities.

Major benefits of upgrading the risk model

Improvements in risk modelling technology lessen the burden of collecting and preprocessing data, allowing more emphasis on the results. There are five items to consider when choosing a new risk model solution:

Only as good as the data

Take advantage of the spatial or relational data within the enterprise database and process it on the fly, thereby eliminating time consuming data compilation and pre-processing. Data should never be generalised or forced to fit into predefined segments. Although risk analysis does not have specific length requirements, the highest level of detail should always be used for the highest resolution in risk scores.

Flexible modelling allows for feedback

Hard coded risk modelling solutions have worked in the past, but the technology, science and subject matter expertise are evolving too fast to have a risk modelling approach that cannot be changed as new best practices become adopted. A flexible risk modelling application will allow for the organisation to control the risk algorithm, rather than being held hostage by an outdated risk model.

Don't forget about the history

Emerging technology allows great flexibility in preserving the integrity of the official risk model while experimenting with other risk algorithms and model types. Documenting the model becomes easier because extensive written material is not needed to describe the complex pre-processing of data. The best documentation already exists from the data owner, describing how they store and integrate their data into the corporate system. This allows the application to manage all of the historical attributes so users can refer back to an older risk algorithm and see exactly how the model and factors were defined.

Dive into the results

Extensive reporting capabilities allow for a deeper understanding of the risk results by allowing users to drill down and understand how threats contributed to the risk score. Reports also allow for the easy organisation and presentation of results and contributing factors so that this information can be shared throughout the organisation including with less technical personnel. Reports are the basis for mitigation decision making and will be the most used aspect of any risk modelling application. Furthermore, reports can help identify errors in data, how factors were processed, and filter data for scenarios such as high consequence areas or high voltage electric transmission lines.

Share the wealth of information

Publishing the risk results back into the database is the last key goal for a risk modelling application. By publishing the results back to the database, other users can access the information and plot the information on integrity alignment sheets or review the data in GIS or other map viewing applications. By sharing the results, risk engineers will receive more feedback from users and be able to continually improve the factor data and risk results.

Conclusion

It may seem like a difficult decision to upgrade a risk model because it involves defining new processes and a significant amount of management of change. However, next generation risk modelling applications, such as GeoFields' RiskFrame® Modeler, can make the decision to upgrade easier. The new risk models will help optimise the process of performing risk analysis and improve decision making based on the results. Coupling next-generation risk modelling applications with an enterprise data management strategy, risk engineers can focus attention to understanding threat contributions and their impact on one another. It is important to remember, the ultimate goal of upgrading the model is to provide the organisation with a more methodic and accurate way of calculating risk along the pipeline to ensure public safety and ecological health.