Risk-Based Leak Survey Enabled by Advanced Methane Detection and Data Analytics

PICARRO

WHITE PAPER

Introduction

Picarro's mobile leak detection solution – combining data analytics with an advanced vehicle-based methane emissions data collection platform – now allows natural gas leak plume data to be collected and interpreted at a speed and scale not previously possible. Further, advances in Big Data Analytics allow better-informed conclusions to be drawn from that data and enable improved decision making and outcomes. A recent example is described here, demonstrating how this combination of methane data and data analytics is being developed in a partnership between Picarro and a utility to measurably accelerate risk reduction and simultaneously reduce Operations & Maintenance costs (O&M) at the utility.

The Vision for a Risk-Based Compliance Survey Framework

Picarro and the utility worked together to develop a predictive leak model to explore the concept of risk-based leak survey. The model predicts the number of leaks per map area using multiple data sources: historical below-ground leak data, mobile Picarro survey data (methane emissions) and the utility's current DIMP (Distribution Integrity Management Program) risk model scores per map area. The motivation for this work is the utility's desire to focus leak surveys on the areas with potentially more leaks. Risk-based survey will identify areas with higher probabilities of leaks and accelerate the surveys of these areas. The areas to be surveyed will be prioritized independently of the time interval since previous survey. Once operationalized, this framework will allow the utility to remove risk from its system much more rapidly than before, while simultaneously helping to optimize both leak survey and repair budgets.

The Opportunity for Improving Models Using Picarro Advanced Leak Survey

Generally, compliance leak survey is conducted in specific map areas according to a fixed schedule (often between one and five years) depending on relatively static qualities of that map relating to the local risk of failure. Risk of failure combines likelihood of failure (i.e. high-risk pipe types) multiplied by consequence of failure (i.e. high population density). This static model can be greatly improved by adding a time-variant *measurement of actual failures* – that is, "real-time" measurements of methane from actual leaks that have developed since the last compliance survey cycle.

It has been shown[1] that an average of 64% of the leaks on natural gas distribution systems are found as a result of odor calls – which incur significant O&M expense and can trigger regulatory penalties – with the remainder being found by routine leak survey. Historical compliance leak data is therefore often both incomplete as well as stale – with some maps having leak data up to five years old. Since leaks develop over time, historical leak data by definition cannot be complete. Further, Picarro has shown with very large datasets in double-blind comparisons between traditional leak survey and Picarro's advanced leak survey, that traditional survey on average finds about 33% of hazardous, below-ground leaks in an area versus 93% found using Picarro's advanced leak survey. The performance difference is due to the combination of methane, geospatial and atmospheric data and analytics, coupled with the significantly higher methane sensitivity of the Picarro system.

[1] U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, Final Report No. 12-173, Leak Detection Study – DTPH56-11-D- 000001, David Shaw et al., December 10, 2012.

Methane and predictive leak data from Picarro's system can therefore be added – at any desired frequency – to existing survey scheduling and risk models to produce vastly improved, truly risk-based survey scheduling models. This data is both more accurate and more timely than historical leak data and it can be taken very rapidly on the system, providing a high-frequency time component to a risk model that incorporates it. Importantly, this data can be collected outside of the normal compliance leak survey process and in a manner that does not produce leak indications, therefore does not triggering the duty to investigate individual indications. Improved risk models provide an opportunity for accelerated risk removal and cost efficiencies that benefit ratepayers.

Leak Distributions

Within the utility's infrastructure, most below-ground leaks are found in a small number of maps (maps). Shown in Figure 1 below, half of these leaks are found in just 12% of maps, and the majority (41%) of maps have no below-ground leaks at all. The idea of a risk-based compliance survey framework is to *accelerate* the frequency of survey activities on the most leak-dense maps, visiting those with few or no leaks on a significantly *reduced* frequency. As the utility moves towards a full-system, annual survey cycle in 2018 in an effort to comply with a regulatory methane emissions ruling, this model would also be dynamically updated using that system-wide methane data as input. In so doing, the schedule of maps for accelerated survey would be continuously reassessed and refined using the high-frequency methane data.

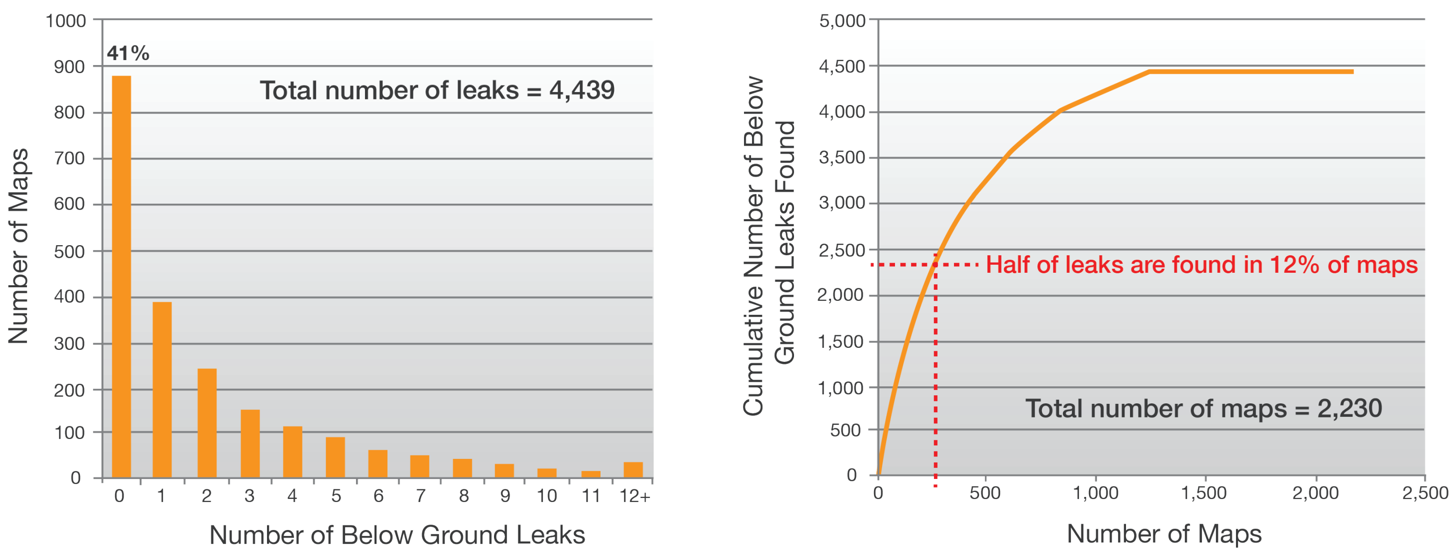
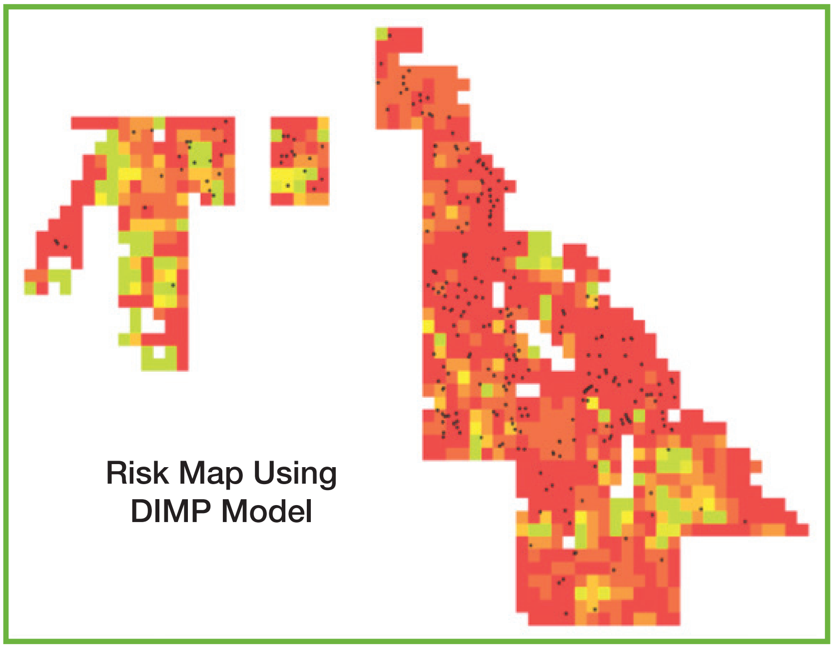


Figure 1. Most leaks are found in a small number of maps, with many maps having no leaks.

Model Performance

To highlight the degree to which models with and without methane data would predict risk, a comparison can be made between the utility's current DIMP model and a Combined model that uses Picarro methane data on top of the DIMP model. In an example (see Figure 2) of 4000 miles of distribution main where the 1% highest risk map tiles are identified and the number of below-ground leaks in those tiles is totaled, the DIMP model identifies 60 leaks in the top 1% whereas the combined model identifies 165 leaks in the top 1%. Tiles that the DIMP model predicts as high risk in some cases have no leaks, and vice versa. The Combined DIMP + Methane model does a better job of predicting where leaks will be located. More granular models enhanced with methane data offer a tremendous opportunity for improving capital efficiency of pipe replacement projects.



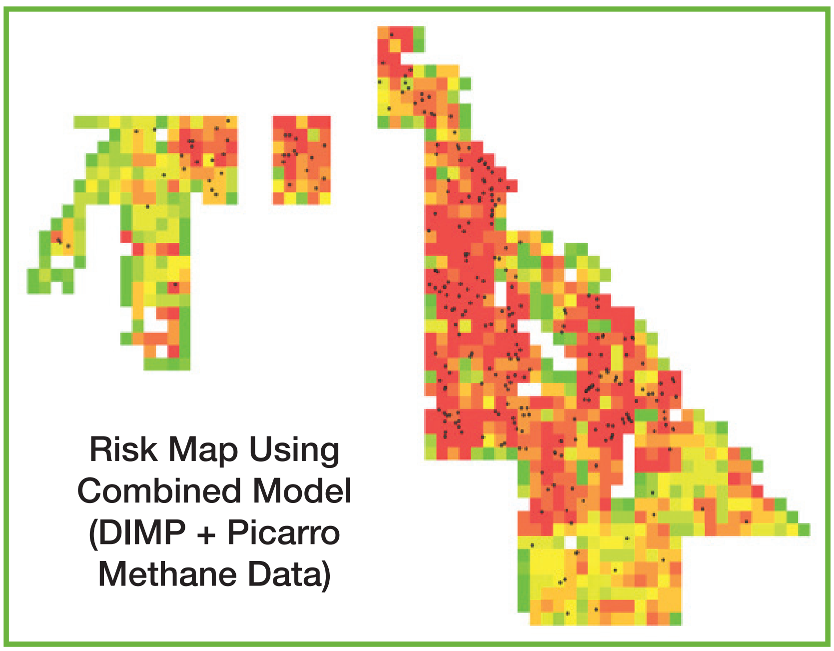


Figure 2. Subset of 4000 miles dataset. Example maps showing the performance of the DIMP and Combined models. Risk per map tile is indicated by color (red=high risk) and leaks found during subsequent compliance survey are indicated by black dots.

As shown in Figure 3 below, in 2017, 700k services were surveyed yielding 5,740 below-ground, gradeable leaks. Using the Combined Model for risk-based survey, 5,740 leaks would be found by only needing to survey 350k services. *This is a 50% reduction in survey effort that yields the same number of leaks through compliance survey.* Now, consider the case where the risk-based survey model is used but the level of survey effort is equal to that from 2017 (i.e. survey 700k services). In this case, 9500 leaks would be found, representing a substantial decrease in system risk in the same period of time using the same budget as was expended in 2017.

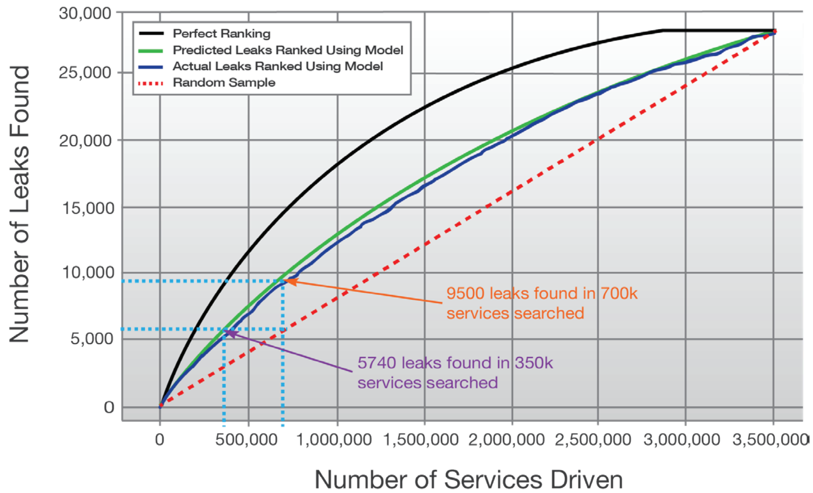


Figure 3. Leaks found vs. services surveyed using Picarro. Without a risk-based survey model, the number of leaks found increases linearly (red) with the number of services. Applying a risk-based model improves this performance. A perfectly performing model (black) is shown compared to a prediction of model performance (green) and actual model performance (blue).

As shown in *Figure 4*, the velocity of remediation of hazardous leaks can be dramatically increased by adopting a risk-based survey framework, which uses Picarro's Risk Ranking Analytics for compliance leak survey combined with the implementation of a data model that incorporates a combination of both methane, historical leaks and other existing DIMP data.

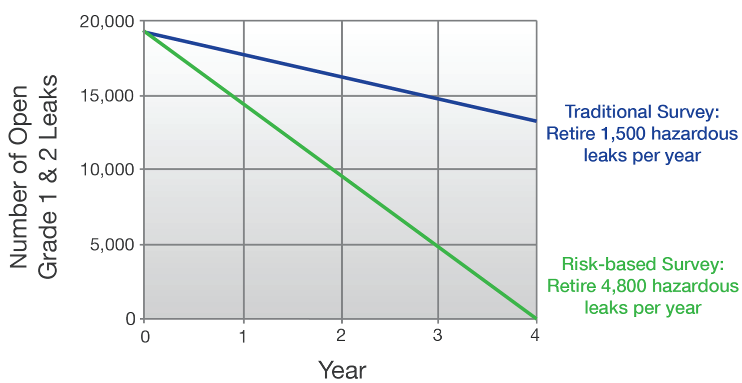


Figure 4. Accelerated Risk Reduction. In this example using actual leak data, risk-based survey is shown to dramatically improve the velocity of risk reduction.

Conclusion

New opportunities are enabled by using methane data in asset management scenarios. Methane data enables utilities to take a risk-based operational approach resulting in following benefits:

- More accurate and predictive forecasting of deployment of leak survey and repair resources
- Labor and O&M efficiencies (using less resources to remove the same amount of important leaks)
- Accelerated removal of risk from the system
- Improved regulatory dialogue (clearly articulate benefits for the ratepayer) – cost effective and accelerated risk removal
- Improved labor and construction forecasting
- Risk mapping opportunities

By leveraging methane data, system risk can be reduced faster than previously possible.

LIT CODE: WP01-V2.0-190515

3105 Patrick Henry Drive Santa Clara, CA 95054 | 408-962-3900 | info@picarro.com | picarro.com