**web-based AI-enabled tool**
that **Empowers your data**

# infraPLAN
## Water Mains R&R & AI

# Ask the Experts! #5
## Abandoned Pipes

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# You might be underestimating how soon your water pipes will fail if you don't includeabandoned pipes in your analysis

### An example

We analyze the behavior of "similar" pipes that belong to the same cohort because they degrade in a similar fashion (same material and period of installation, for example). More specifically, we want to predict what the condition of a 55-yr old pipe will be 25 years from now, at 80. Therefore, we pay special attention to the pipes within that cohort that ever reached the age of 80. Some are still active; some have been abandoned (past the age of 80). In reality, "similar" pipes analyzed in a same cohort can never be exactly the same: some are better; some are worse; some are younger; some are older; some may be under the influence of a variable that does not define the cohort or, worse, is not integrated in the model (under a pothole is a good example).

For many reasons, utilities tend to replace pipes in worse condition. Often, they are also older. The table below illustrates that fact at a mid-size utility. It shows the

length,average age and yearly break rate for pipes that were abandoned or are still in service. Abandoned pipes on average were 1.5 times older (80 years old at abandonment, as opposed to 55 at the present time for those still in service). They were also in worse condition with an average yearly break rate 10.5 times higher than for those still in service.

| | Abandoned pipes | Active pipes | Ratio |
|---|---|---|---|
| **Length (miles)** | 98 | 997 | 9.8% |
| **Average yearly Break Rate (Nb breaks/mi/yr.)** | 0.535 | 0.051 | 10.5 |
| **Age** | 80 | 55 | 1.5 |

Let's imagine that there are pipes similar to the ones abandoned that are still in service but in much better condition. If we did not have access to the abandoned pipes data, we would be predicting the behavior of the 55-year-olds in 25 years - which still include good and bad pipes- based on the behavior of the 80-year-olds that are left - which, on another end, are the best ones. This would create a bias: the 55-year-old pipes will be predicted to be in better condition at 80. As a result, the utility may not properly budget R&R investment, and may face service disruptions at an unanticipated level.

> *As a result of ignoring abandoned pipes history, the utility may not properly budget R&R investment, and may face service disruptions at an unanticipated level.*

We could even imagine a scenario in which budgeting would not be possible at all if abandoned pipe and break data are not available. For example, after years of efficient abandonment, the pipes left may, for a while, experience very few breaks (but will certainly start breaking in the future). What would engineers rely on to plan the R&R of the pipes for the next 20 years if no data exist for the pipes that have been abandoned, and the ones left had few breaks? How will they justify their budget requests?

**Let's borrow from human epidemiology to further illustrate our point.**

Would it make sense to predict human longevity by including health data solely on

the living or on the healthy population? Would we know about the risk factors of a diseaseif, in our study, we only included the individuals who recovered or never got sick; and ignored the ones who died?

Statistical analyses of pipes degradation borrow heavily from public health. Both fieldsstudy a population (pipes in the water industry; individuals in public health) over a set period of time, and look for a specific occurrence (break; disease) pertaining to their physical condition. It is obvious that data from the deceased population enhance the accuracy of predicting human life expectancy. It is vital to apply the same principle to pipes experiencing breaks.

In other words, for optimal pipe failure forecasting analyses, all pipes in service at some point during the period of breaks observation should be taken into account, including pipes no longer active.

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## *Does your failure forecasting approach include abandoned pipes?*

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### No abandoned pipe data? What should you do?

The good news (when it comes to analytics) is that, to date, most U.S. utilities have only replaced a small percentage of their original stock of pipes. As a result, missing abandoned pipes data has had limited impact on the accuracy of pipe failure forecasting. However, as utilities start replacing more pipes, the percentage of abandoned pipes will only grow, and the negative consequence of missing those pipes in the analysis will also worsen.

Article #4 describes the data that is necessary to conduct a machine learning-powered break forecasting analysis.

Articles #6 and 7 of this series show how to start collecting that data and how to organize it for integration into an advanced pipe failure forecasting model that can be used both accurately and immediately.

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**infraPLAN-LLC** helps water utilities, large and small, achieve savings on CIP expenses using our ground breaking platform, **infraSOFT.**

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