Data-Driven Failure Prediction on Water Main

Data61 is collaborating with water utilities across the world on innovative data-driven analysis to improve water utilities' network performance. We have developed models for both critical and reticulation water main failure prediction. This model outperforms the current water industry practices.

Background

Data61 have been working with global water utilities since 2012 to use machine learning techniques to develop data-driven models to determine the water mains that are at high risk of failure. Data 61 is the nation's largest organisation dedicated to the research of Information Communications Technology (ICT). Data61's primary goal is to pursue high-impact research excellence and, by applying this research, create national benefit and wealth for Australia.

Model and methodology

Using machine learning techniques Data61 has created a model that determines which water mains are at risk of failure in the next year. This includes both reticulation and critical water mains. Based on this list water utilities could prioritise which pipes should have further 'condition assessment' inspections or renewal performed on them.

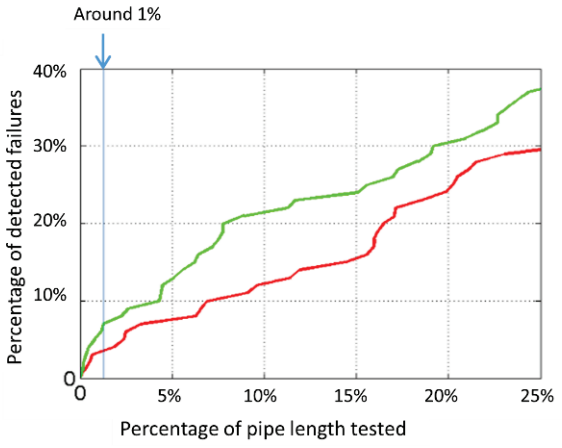
The model uses a range of pipe data including material, laid year, coatings, failure history, and etc. By looking at how these factors impact the previous failures of pipes the relative likelihood of failure between the set of pipes can be determined.

Current success in predicting failures

We validated the outcomes by separating the data into in-sample data and out-of-sample data. The validation is carried out by matching the prediction and out-of-sample data through all the collaborated water utilities.

Benefits and value to customers

With better targeting of high risks pipes for critical water main renewals Sydney Water should reduce cost by several million dollars over a four year price determination period and minimise inconvenience to customers from main breaks



The data validation demonstrated that the Data61 conceptual model identified significantly more failures for the same inspection effort in 2012 for critical water mains. This is highlighted in Figure 1. If 1% of the network was inspected then 100% more failures would have been identified for the same effort.

Data61's model is also validated with reticulation water mains (Figure 2) for long-term prediction. It also significantly outperform other methods when predicting pipes to be renewed.

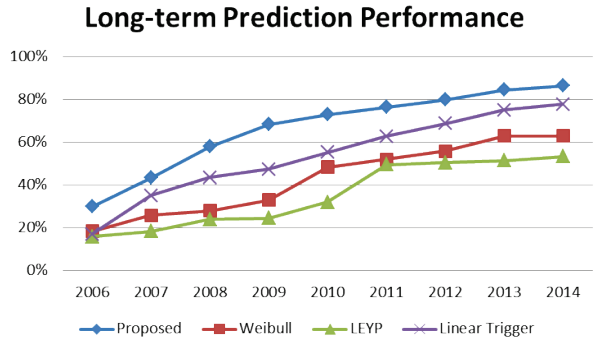


Figure 1 - Performance comparison. Uses 2000-2005 data for training and 2006-2015 data for testing. For each testing year, top 200 pipes with highest cumulative risky intensities and the accuracy is measured by the percentage of the selected pipes that failed between 2006 and testing year.

Software platform

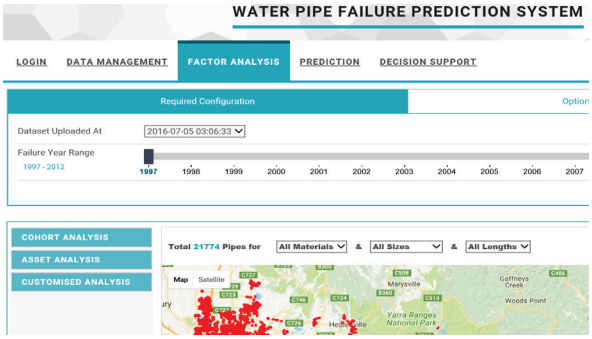


Figure 2 - Platform interface

A software platform (as it is shown in Figure 3) was developed for pipe failure prediction, based on the techniques developed during the collaborative project. This platform would be of vast assistance to water utilities in selecting high risk pipes for preventative maintenance and pipe renewal; especially under various operational constraints, such as pipe selections at trunk main level.

About collaboration

Data61 has set up a series of collaborations with water utilities across the world. The collaborations are based on a partnership arrangement, with Data61 providing data analytics research expertise and water utilities providing data and system knowledge, such as the data map showing in Figure 4. The arrangement ensures that the partnership will deliver value to these water utilities and its customers.

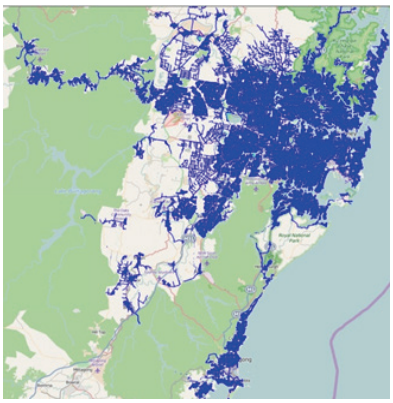


Figure 3 - Map of the pipe network form Sydney

By providing smart prediction, Data61 is collaborating with 30 global water utilities, analysed about 9 million water mains and 700k failure records.

CONTACT US
t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.data61.csiro.au

WE DO THE EXTRAORDINARY EVERY DAY
We innovate for tomorrow and help improve today – for our customers, all Australians and the world.
We imagine. We collaborate. We innovate.

FOR FURTHER INFORMATION
Dr Fang Chen
Enterprise Analytics Group Leader
t +61 2 9490 5601
e fang.chen@data61.csiro.au
w www.data61.csiro.au